FINAL

2002 MONITORING WELL INSTALLATION AND GROUNDWATER SAMPLING TECHNICAL MEMORANDUM

NORTHWEST PIPE AND CASING OPERABLE UNIT 2 GROUNDWATER REMEDIAL DESIGN

NW Pipe and Casing/Hall Process Company
Clackamas, Oregon

January, 2003

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1.0 INTRODUCTION

This technical memorandum describes the results of drilling, monitoring well installation, and groundwater sampling activities conducted at the NW Pipe and Casing/Hall Process Company (NWPC) site in Clackamas, Oregon (Figure 1). URS conducted these activities in support of the Remedial Design (RD) for Groundwater Operable Unit (OU) 2. The OU 2 selected remedy is described in the *Record of Decision* (ROD) for OU 2 [U.S. Environmental Protection Agency (EPA), 2001].

Historical mishandling of chlorinated solvent wastes generated during pipe-coating activities at the site resulted in contamination of groundwater with volatile organic compounds (VOCs). The ROD identifies three VOCs as Chemicals of Concern (COCs): tetrachloroethene (PCE), trichloroethene (TCE), and vinyl chloride (VC). The COCs have been identified at four groundwater contaminant plumes, referred to as Plumes 1 through 4. The plume footprints, as defined by the 2002 PCE and TCE groundwater concentrations, are shown on Figures 2 through 5. Plumes 1, 2, and Plume 4 are commingled, with Plume 4 being a smaller area of high COC concentrations within the larger Plume 1 footprint. Total COC plume maps, based on the sum of PCE, TCE, and VC concentrations, are shown on Figures 6 and 7. For comparison, the 2000 plume footprints, as illustrated in the ROD, are provided in Appendix A. The remediation goals (RGs), as specified in the ROD for PCE, TCE, and VC, are 1.0 μg/L, 1.6 μg/L, and 1.0 μg/L respectively. The selected remedy calls for the installation of groundwater circulation wells (GCWs), using in-well air sparging to treat and contain the most highly contaminated groundwater, and use of natural processes to address lesser-contaminated groundwater at the site.

2.0 SUMMARY OF DRILLING AND MONITORING WELL INSTALLATION

2.1 Monitoring Well Installation

URS installed eight new monitoring wells at the site. Boring logs are provided in Appendix B and well construction details are provided on Table 1. The monitoring wells (see locations on Figures 2 through 8) were installed at the following locations:

- Installation of a shallow and intermediate upper aquifer monitoring well pair (MW-113 and MW-114) immediately down gradient of the former drum burial area at Excavation Area (EA) 2. During the Remedial Action (RA) for Soil OU 1 (completed in 2001), VOC-containing non-aqueous phase liquids (NAPLs) were identified at EA 2. The purpose of this monitoring well pair is to evaluate whether dissolved-phase VOC contamination is associated with the small quantities of NAPL.
- Installation of a shallow, intermediate, and deep upper aquifer well cluster (MW-115, MW-116, and MW-119) immediately downgradient of the former buried "slotted tank" at former Plant 2. The tank was removed during the OU 1 RA. The purpose of this monitoring well cluster is to evaluate whether dissolved-phase VOC contamination is associated with the NAPL that is present in the soil at former Plant 2.
- Installation of a deep upper aquifer well (MW-120) at the location of the former slotted tank at former Plant 2. The purpose of this monitoring well is to evaluate the depth of NAPL and dissolved-phase VOC contamination below the slotted tank.
- Installation of a shallow and intermediate upper aquifer well pair (MW-117 and MW-118) down gradient of the former slotted tank. The purpose of this monitoring well pair is to evaluate the downgradient extent of dissolved-phase VOC contamination associated with NAPLs in the soil at Plant 2.

The shallow and intermediate upper aquifer borings were advanced using a B-16 ODEX drilling rig. The deep upper aquifer borings were advanced using a Foremost DR-24 dual-wall air-rotary drilling rig. Drill cuttings and formation water discharged directly to a temporary holding container. Once full, the container was moved to the investigative derived waste (IDW) storage area. Water was pumped from the container into two 4,000 gallon Baker tanks. Soil cuttings were placed into two 20-yard roll-off boxes.

The monitoring wells were completed as shown on Table 1 and Appendix B. Following completion, each monitoring well was developed using submersible pumps. The wells were surged multiple times, and specific conductance, pH, turbidity, dissolved oxygen, and temperature were monitored. Development was terminated once the measured parameters stabilized and the water became relatively clear (turbidity typically less than 100 NTU). Well development datasheets are provided in Appendix C.

2.2 Observations During Drilling

2.2.1 Geologic Conditions

A URS geologist logged the drill cuttings during boring advancement, and noted any visual or olfactory evidence of contamination. Soil samples (i.e. split spoons or cores) were not collected. Overall, the geologic formations observed were consisted with those previously identified at the site. Silt with clay and clayey silt (the upper silt unit) was observed to a depth of five to seven feet. Underlying this is the upper aquifer (the upper gravel unit), which consists of gravel with sand and silt or gravel with sand. The silt content generally decreased with depth. At MW-119, the upper gravel unit is underlain by sandy silt to silty sand (the lower silt unit) at a depth interval of 113 to 116 feet. The lower silt unit, in turn is underlain by the lower aquifer (the lower gravel unit), consisting of gravel with sand to a depth of 136 feet. Sandy silt was encountered at 136 feet and the boring was terminated in the sandy silt at a depth of 140 feet.

At MW-120, the upper gravel unit includes a gravel with silt from 105 to 108 feet. The upper gravel unit is underlain by silt/siltstone (presumably correlative with the lower silt unit at MW-119) at 122 feet. The boring was terminated in the silt at a depth of 125 feet.

2.2.2 Observed Evidence of Contamination

Visual and olfactory evidence of contamination was observed during advancement of several borings, as discussed below. Visual evidence consisted of a sheen on drill cuttings and/or formation water produced during drilling. Olfactory evidence consisted of a "creosote-like" odor.

At the MW-113/MW-114 well pair downgradient of the drum burial area, a slight sheen was noted on the cuttings at a depth of 10 feet at MW-113. No sheen was observed during advancement of MW-114.

At the MW-115/MW-116/MW-119 well cluster immediately down gradient of the former slotted tank, a sheen and creosote odor was first observed at a depth of 13 feet. Both the sheen and creosote odor became quite pronounced below a depth of 20 feet to about 60 feet. At MW-119, the sheen and odor became progressively less pronounced/more "spotty" with depth. A sheen was not observed below 75 feet, although a weak creosote odor was noticeable to a depth of 116 feet (the bottom of the lower silt unit).

At the MW-117/MW-118 well pair, located further downgradient from the MW-115/MW-116/MW-119 well cluster, a sheen was not observed, and only a slight creosote odor was noted from a depth of 13 to 20 feet.

Finally, at MW-120, located at the approximate location of the former slotted tank, a spotty sheen and weak creosote odor was first observed at 7 feet (the top of the upper gravel). At 21 feet the sheen became more continuous and the odor more prominent. At 35 feet the sheen became continuous on the soil cuttings and the odor very noticeable. At 50 feet, the sheen became less prominent/more spotty. At 95 feet the sheen became very spotty and the odor

moderate. At 99 feet no sheen was observed, and the odor was weak. Finally, a creosote odor was not observed below 108 feet (below the gravel with silt from 105 to 108 feet).

In summary, strong evidence of NAPL (a sheen) was observed at the location of the former slotted tank (MW-120), and about 150 feet down gradient (at the MW-115/MW-116/MW-119 well cluster). The evidence was most strong (as indicated by a nearly continuous sheen on the drill cuttings) from about 20 to 60 feet, with the sheen becoming more spotty below that depth. At the MW-113/MW-114 well pair, only a slight sheen was observed at 10 feet.

These observations are consistent with the apparent magnitude of the NAPL source at the drum burial area and the slotted tank. At the drum burial area, about 50 NAPL-containing 55-gallon drums were removed during the OU 1 RA. This places a maximum limit on the source volume of 2,750 gallons of NAPL. At the slotted tank, the volume of NAPL was likely greater. Because of the slotted nature of the tank, it appears to be a disposal site for solvent/coal tar mixtures. Pipe coating apparently occurred at the site from 1956 to 1985. Given the period of operation during which disposal at the slotted tank could have occurred, it is likely that the total volume of source material at Plant 2 greatly exceeds that of the drum burial area, which is consistent with the NAPL observations during drilling.

3.0 SAMPLING ACTIVITIES

URS collected groundwater samples at the locations shown on Table 2. In addition, URS collected samples of Investigative Derived Wastes (IDW) for waste characterization prior to disposal, and attempted to collect a sample of NAPL at the former Plant 2 area. Sampling and Quality Assurance/Quality Control (QA/QC) procedures for all sampling activities are described in detail in the *Quality Assurance Project Plan and Sampling and Analysis Plan* (URS, 2002).

3.1 Groundwater Sampling

Groundwater sampling activities were conducted at 49 monitoring wells. Prior to the sampling activities, URS collected groundwater elevation data from 50 monitoring wells (Table 9). Groundwater elevation contours for the shallow upper aquifer are shown on Figure 25. On the Oregon Department of Transportation (ODOT) property, the groundwater flow direction is generally to the north. The groundwater flow direction is somewhat irregular on the southern portion of the site. Specifically, a groundwater depression was observed in the vicinity of MW-115 through MW-119. Water level readings were collected shortly after installation and development of MW-115 through MW-119, and the groundwater depression observed at this location may reflect groundwater withdrawals associated with development of these wells.

Forty-nine of the wells were sampled, and all groundwater samples were analyzed for VOCs using Method OLC03.2 or OLM04.2. A groundwater sample was not collected from monitoring well MW-112. Wells with casing diameters of 2 inches or greater were sampled using passive diffusion sample bags (PDSBs). For monitoring wells with casing diameters of 2 inches or greater and 4-, 5- or 6-foot screened intervals (39 wells), one diffusion bag was deployed so that the center point of the PDSB sampler was at the vertical midpoint of the saturated well-screen length. Six wells at the site have 10-foot screened intervals and were sampled using two PDSBs, one above and one below the midpoint of the screen. The PDSBs do not fit in wells with casing diameters smaller than about 2 inches; therefore, three wells with approximately 1-inch diameter casings (PZ-05, PZ-06, and PZ-13) were sampled using the low-flow sampling procedure only.

Four wells (one well located in each of the four plumes) were also tested for the parameters used to calculate the Ryznar Index (calcium, total alkalinity, and total dissolved solids). In order to test for the Ryznar parameters, these four wells (MW-04, MW-15, MW-20, and MW-103) were sampled using low-flow sampling procedures (in addition to the PBSBs for VOCs). Low-flow procedures involved purging groundwater at a rate that minimized drawdown of the water level in the well during sampling. Low-flow sampling included the measurement of field parameters (pH, specific conductance, temperature, dissolved oxygen, and turbidity). Groundwater samples were collected only after the field parameter measurements had stabilized.

Groundwater analytical results are discussed in detail in Section 4.0.

3.2 IDW Characterization

Drilling, monitoring well installation, and groundwater sampling activities generated soil and water IDW. Water IDW was stored in two 4,000 gallon Baker tanks. At total of 7,386 gallons of water was generated during the field activities. Soil cuttings were stored in two 20-yd^3 roll-off boxes. A total of about 15 yd^3 of soil was generated during drilling.

A single water sample was collected from each Baker tank using a disposal HDPE bailer. Both samples were analyzed for VOCs (Method 8260), polynuclear aromatic hydrocarbons (PAHs) (Method SW-846 8270C) and polychlorinated biphenyls (PCBs) (Method SW-846 8082). The analytical results are provided in Tables 3 through 5. Based on the results, the water was classified as a non-hazardous waste, and disposed of at Spencer Environmental's water treatment facility at 6400 SE 101st Ave, Portland, Oregon.

A single soil sample was collected from each roll-off box. Each sample consisted of a composite of four samples from each roll-off box. The samples were analyzed by the same methods listed above for the water IDW samples. The analytical results are provided in Tables 3 through 5. The soil analytic data were compared with the OU 1 Excavation Criteria (EC). Because the soil results did not exceed the EC for each of the OU 1 COCs, the soil IDW was placed on site within the footprint of OU 1 Excavation Area 6.

3.3 Plant 2 NAPL Characterization

URS attempted to collect a sample of the NAPL from the vicinity of the former slotted tank at Plant 2. The intention of this effort was to characterize the composition of the NAPL, via analysis for VOCs, PAHs, and PCBs, and to determine the transport properties of the NAPL, via viscosity, capillary pressure, interfacial tension, and density analyses. Six test pits were excavated downgradient of the former slotted tank. All test pits were excavated to the depth of groundwater, which was approximately 10 feet. Soils exposed in the test pits consisted of clayey silts and silt with gravel to a depth of about 8 feet, and gravel (upper aquifer) below this depth. NAPL was observed discharging from the gravel into the test pit. At all locations, the NAPL formed a continuous sheen on the surface of the water. However, the sheen was not of sufficient thickness to permit collection of a sample.

4.0 GROUNDWATER SAMPLING RESULTS

The primary purpose of the 2002 groundwater sampling event was to assist with decision making for GCW placement as part of the OU 2 RA. The ROD specifies use of GCWs to address "highly contaminated groundwater" and natural processes to address "lesser contaminated groundwater". The work described in this document focused on evaluating COC trends at each monitoring well to identify locations where significant COC reduction has occurred. Relying on natural processes is appropriate at locations where significant COC reduction is occurring or COC concentrations remain near the RGs. GCWs will be proposed for locations where significant COC reduction is not occurring and COC concentrations are well above the RGs.

Historic groundwater data provide considerable insight with respect COC trends. However, during the development of the RD strategy, several data gaps were identified that necessitated groundwater sampling in 2002 for the following reasons:

1. During the 2001 groundwater sampling event, PDSBs were used to collect groundwater samples at all monitoring locations. At four locations, samples were also collected using the low-flow pumping method. During previous monitoring events, only the low-flow pumping methods were used. For the 2001 sampling event, COC concentrations generated by the PDSB sampling method were consistently higher than those generated by the low-flow pumping method. In addition, COC concentrations at several monitoring locations were higher in 2001 than during previous monitoring events, including at locations where COC concentrations had been consistently decreasing over time. Therefore, the 2002 groundwater sampling used PDSBs at all locations to evaluate the extent to which the higher concentrations observed in 2001 were the result of the PDSB sampling method. Duplicate samples were collected at selected wells using the low-flow pumping method. If the analytical results generated by the PDSBs were lower this year than in 2001 (in particular, at locations where contaminant concentrations had been on the decline prior to 2001), then the increase in contaminant concentration seen in 2001 would be attributed to conversion to the PDSB sampling method, and the overall interpretation would be that contaminant concentrations are continuing to decrease. Otherwise, if the results were similar to or higher this year than in 2001, then the increase seen in 2001 and again as part of this sampling event would be attributed to an actual increase in groundwater contaminant concentrations, regardless of any affect associated with the PDSB sampling method.
2. Several wells at each plume have been selected as monitoring points for evaluating the extent to which natural processes are addressing lesser-contaminated groundwater. At monitoring well locations with decreasing contaminant concentrations or historically low concentrations, it appears that natural processes are reducing COC concentrations to the extent that GCWs may not be necessary to treat groundwater at these locations. The 2002 sampling event was proposed to evaluate the extent to which previously observed trends in COC concentrations are consistent with the interpretation that natural processes

are continuing to reduce COC concentrations. Specifically, if the monitoring results indicate a continuation of previously observed contaminant reduction trends, then these locations would be selected as candidate locations for allowing natural processes to continue as a means of improving groundwater quality.

3. The 2002 groundwater samples were analyzed for the parameters needed to calculate the baseline Ryznar Index values for each plume. The Ryznar Index is an indicator for the potential of GCWs to become fouled during operation.
4. Finally, at several monitoring locations, only two sampling events have been completed. The 2002 sampling event generated additional data to facilitate interpretation of the trend in COC concentrations at these locations.

Table 6 summarized the 2002 groundwater COC analytical data as well as data for the COC breakdown products. Table 7 summarizes the historic COC concentration and trends at each monitoring location. Various COC plume maps are provided on Figures 2 through 8.

4.1 Effect of PBSDs on Analytical Results

PDSB and low-flow sampling was conducted at MW-04, MW-15, MW-20, and MW-103 (Table 6). At MW-15, MW-20, and MW-103, the results for both methods were very similar, with no large differences in COC concentrations between the two methods. At MW-04, low-flow sampling resulted in much higher PCE and TCE concentrations, but a much lower VC concentration. In particular, PCE was not detected by the PDSB method whereas the low-flow method detected PCE at a concentration of 32.2 µg/L. Overall, the two methods appear to general results that are comparable.

4.2 Overall COC Trends

4.2.1 Plume 1

Overall, the 2002 analytical data indicate that COC concentrations are continuing to decrease through most of the footprint of Plume 1. Notable contaminant reduction has occurred at MW-04, MW-06, MW-07, and MW-18 (mainly PCE) (Figures 9 through 12). At MW-16 and MW-19 (Figures 13 and 14), PCE and TCE have increased in the last two years. At MW-111, located off site to the north of Lawnfield Road, PCE and TCE have been detected at 1 µg/L, indicating potential migration of the plume off site. At MW-12, TCE has been detected at 1.5 µg/L, indicating potential expansion of the plume to the east (although 1.5 µg/L is below the RG of 1.6 µg/L). At the remaining monitoring well locations, COC concentrations are generally below the RGs or non-detect.

Overall, the Plume 1 footprint has not changed significantly. The shallow upper aquifer PCE plume (Figure 2) is slightly narrower due to the MW-07 concentration being below the RG. However, the plume now extends further north due to the 1-µg/L detection at MW-111. The intermediate upper aquifer PCE plume (Figure 3) is very limited in extent due to the MW-17 and

MW-18 COC concentrations being below the RG. The plume is confined to the area around MW-16.

The shallow upper aquifer TCE plume (Figure 4) is unchanged, with the exception of the 1-µg/L detection at MW-111, which is below the RG, but may indicate migration of the plume north. The intermediate upper aquifer TCE plume (Figure 5) is very limited in extent due to the non-detection at MW-17. The plume is confined to the area around MW-16 and MW-18, although 1.5-µg/L detection at MW-112, which is below the RG, may indicate expansion of the plume to the east.

4.2.2 Plume 2

COC concentrations at Plume 2 are somewhat variable. At MW-02 (Figure 15), PCE is below the RG, TCE is near the RG, but VC remains relatively high. At MW-101 through MW-103 (Figures 16 through 18), COC concentrations are variable and show no particular trend. At MW-104 and MW-105 (Figures 19 and 20), COC concentrations have increased slightly. At the remaining monitoring well locations, COC concentrations are generally below the RGs or non-detect.

PCE and TCE analytical data for new monitoring wells MW-113 through MW-118 indicate that the Plume 2 boundaries extend further south (toward the drum burial area), east (toward former slotted tank at Plant 2), and northeast within both the shallow and intermediate upper aquifer. Plume 2 appears to be comingled with Plume 1. In the vicinity of Plant 2, the plume is confined to the shallow and intermediate upper aquifer. At MW-119 and MW-120, screened within the deep upper aquifer, COC concentrations were non-detect.

4.2.3 Plume 3

COC concentrations at Plume 3 are somewhat variable. At MW-01 (Figure 21) PCE and TCE have increased slightly after a period of decreased concentrations. At MW-15 (Figure 22), PCE and TCE have increased after a period of significant reduction in concentration. At PZ-05 (Figure 23), PCE and TCE have increased slightly after a period of slight decrease. At the remaining monitoring well locations, COC concentrations are either slightly above the RGs, below the RGs, or non-detect.

The overall footprint of Plume 3 has not changed significantly.

4.2.4 Plume 4

Plume 4 is comingled with Plume 1. At MW-20 (Figure 24), COC concentrations have decreased slightly after a period of increased concentration. At the remaining monitoring location (MW-17), COC concentrations are below the RGs or non-detect.

The shallow upper aquifer PCE and TCE plume footprint is unchanged. The intermediate upper aquifer PCE and TCE plume is non-existent due to the concentrations being below the RG or non-detect at MW-17.

4.3 Ryznar Index Results

The Ryznar Stability Index (RSI) predicts the corrosive or incrusting tendencies of a particular water. It is widely used for predicting the reaction of solid metals in saturated conditions. A water is corrosive if the index is higher than 7 and incrusting if lower than 7. The RSI is calculated based on alkalinity, total dissolved solids, total calcium, and pH data using the following formula:

$$I = S - C - pH$$

where I is the Ryznar Index, S is a factor derived from a standard curved developed for total dissolved solids data, and C is a factor based on a standard curve developed for alkalinity and total calcium data.

The analytical results for the RSI parameters and the calculated RSI values are summarized in Table 8. The RSI values for all four plumes range from 8.49 to 9.80, indicating a potential for corrosion.

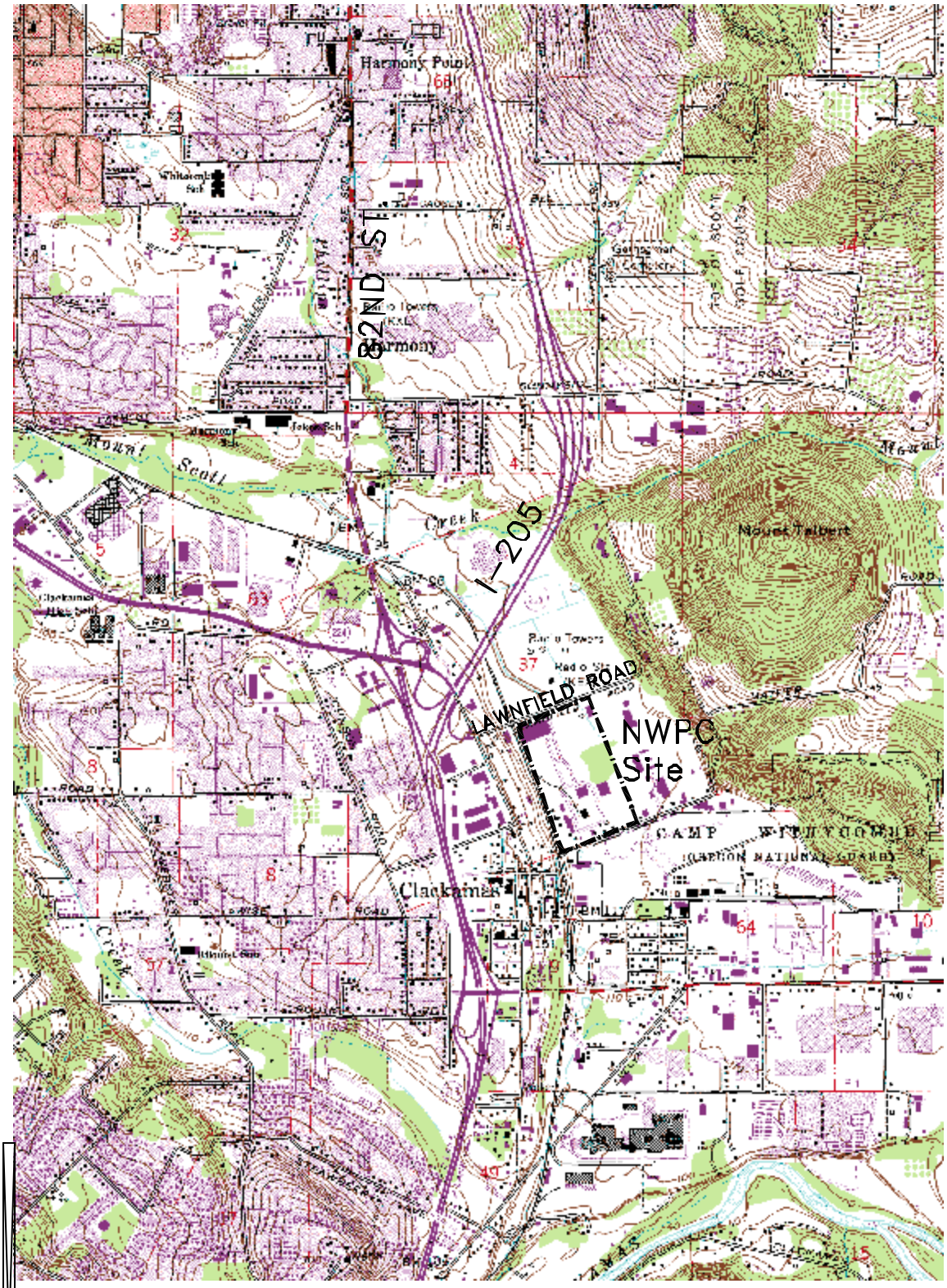
The *Remedial Design Strategy Technical Memorandum* (URS, May 2002) calculated RSI values based on historic analytical data for the site. The results ranged from 7.9 to 8.6. The technical memorandum incorrectly stated that these values indicated a potential for "inorganic fouling" (i.e. incrustation). In fact, these values indicate a potential for corrosion, which is consistent with the RSI values calculated above using the October 2002 data. Corrosion can be mitigated by using PVC or stainless steel well casing and screen.

URS Corporation. May, 2002. *Remedial Design Strategy Technical Memorandum*. Prepared for U.S. Environmental Protection Agency.

URS Corporation. July 26, 2002. *Quality Assurance Project Plan and Sampling and Analysis Plan.* Prepared for U.S. Environmental Protection Agency.

U.S. Environmental Protection Agency. September 2001. *Record of Decision*. Northwest Pipe and Casing Company/Hall Process Company Groundwater Operable Unit (OU 2), Clackamas County, Oregon. CERCLIS Identification Number: ORD 980988307.

FIGURES



VICINITY MAP

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GROUNDWATER OPERABLE UNIT 2

VICINITY MAP

DRAWING NUMBER: FIGURE 1

CAD FILE NUMBER: C-01

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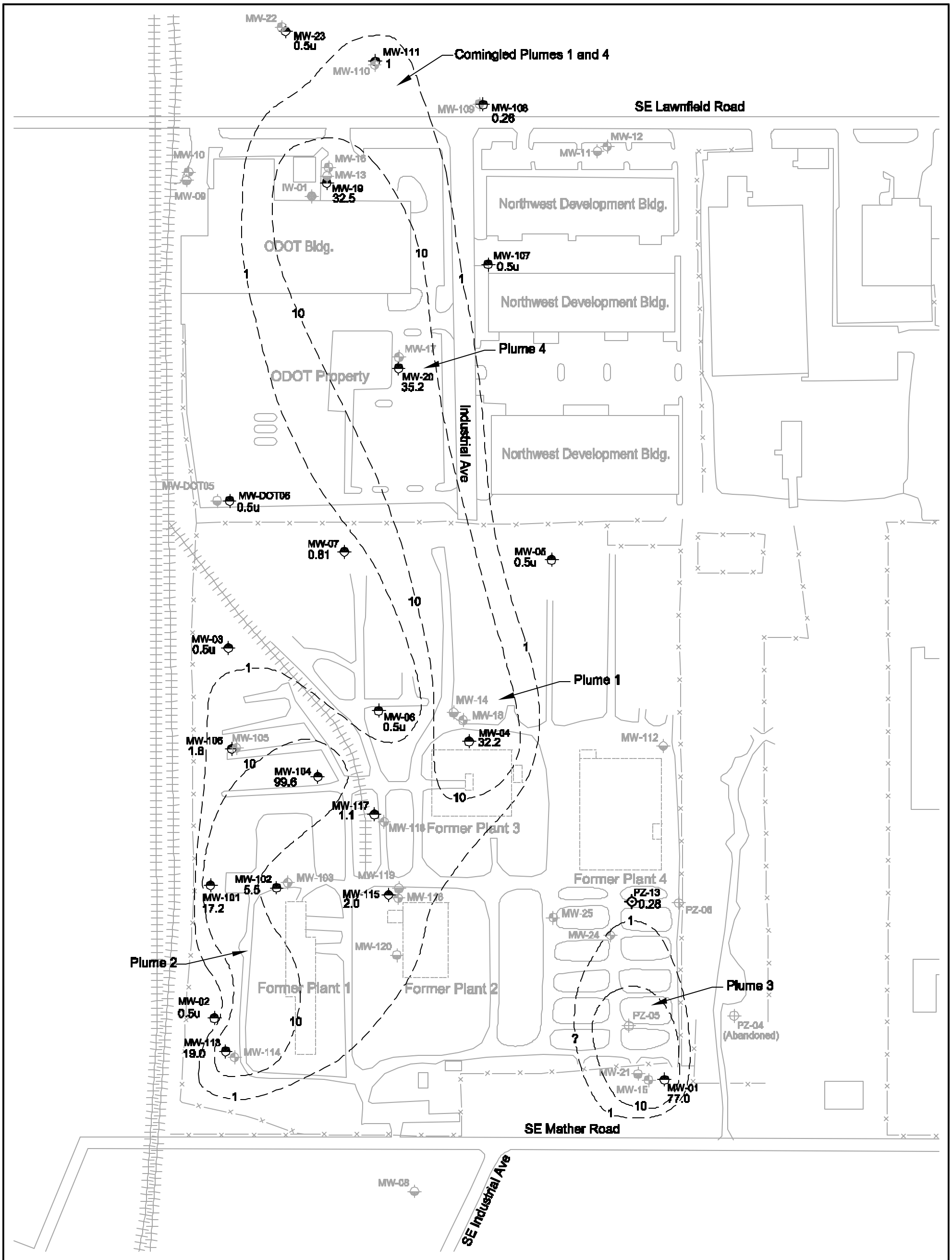

LEGEND

- Shallow Upper Aquifer Well (0-20 feet bgs)
- Intermediate Upper Aquifer Well (20-60 feet bgs)
- Lower Upper Aquifer Well (60-110 feet bgs)
- Lower Aquifer Well (115 feet bgs)
- Shallow Upper Aquifer Piezometer (0-20 feet bgs)
- Intermediate Upper Aquifer Piezometer (20-60 feet bgs)

Groundwater Concentration & Contour Interval
Units in ug/L.

Figure 2
PCE Plume Boundary
Shallow Upper Aquifer
(Based on 2002 PCE Groundwater Concentrations)

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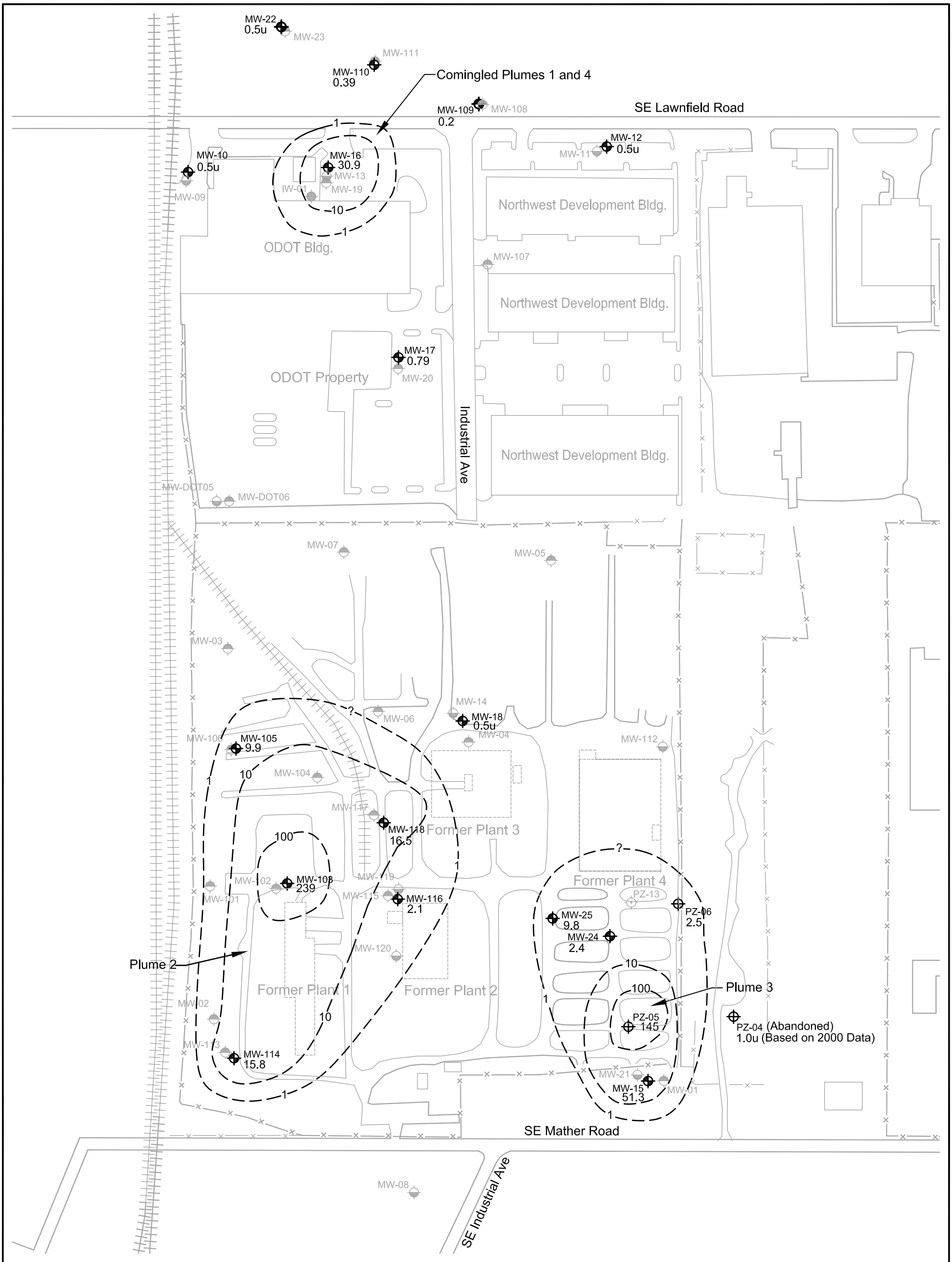

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Groundwater Concentration & Contour Interval
Units in ug/L.

Figure 3
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(Based on 2002 PCE Groundwater Concentrations)

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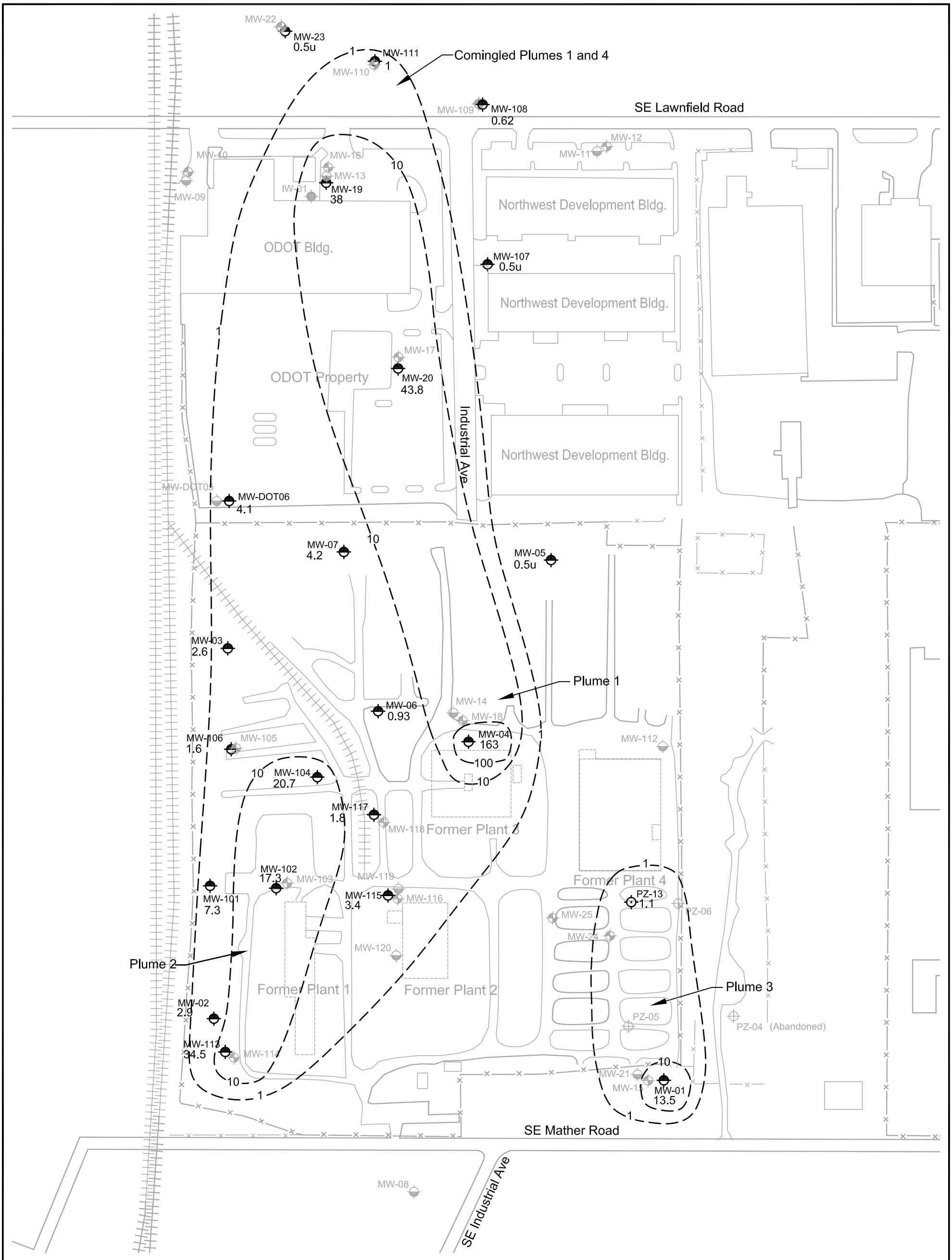

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Groundwater Concentration & Contour Interval
Units in ug/L.

Figure 4
TCE Plume Boundary
Shallow Upper Aquifer
(Based on 2002 TCE Groundwater Concentrations)

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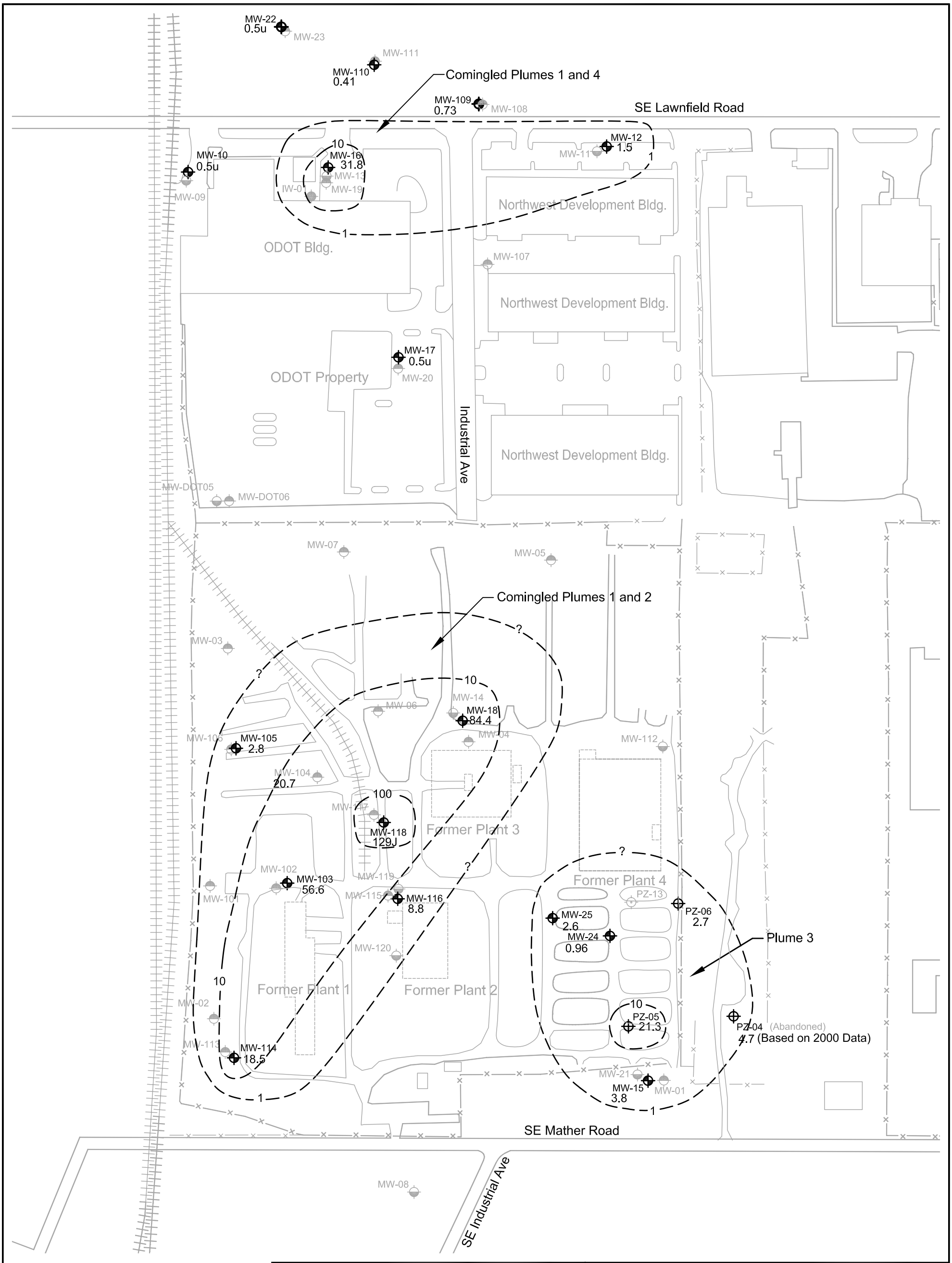

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- Lower Upper Aquifer Well (60-110 feet bgs)
- Lower Aquifer Well (115 feet bgs)
- Shallow Upper Aquifer Piezometer (0-20 feet bgs)
- Intermediate Upper Aquifer Piezometer (20-60 feet bgs)

Groundwater Concentration & Contour Interval
Units in ug/L.

Figure 5
TCE Plume Boundary
Intermediate Upper Aquifer
(Based on 2002 TCE Groundwater Concentrations)

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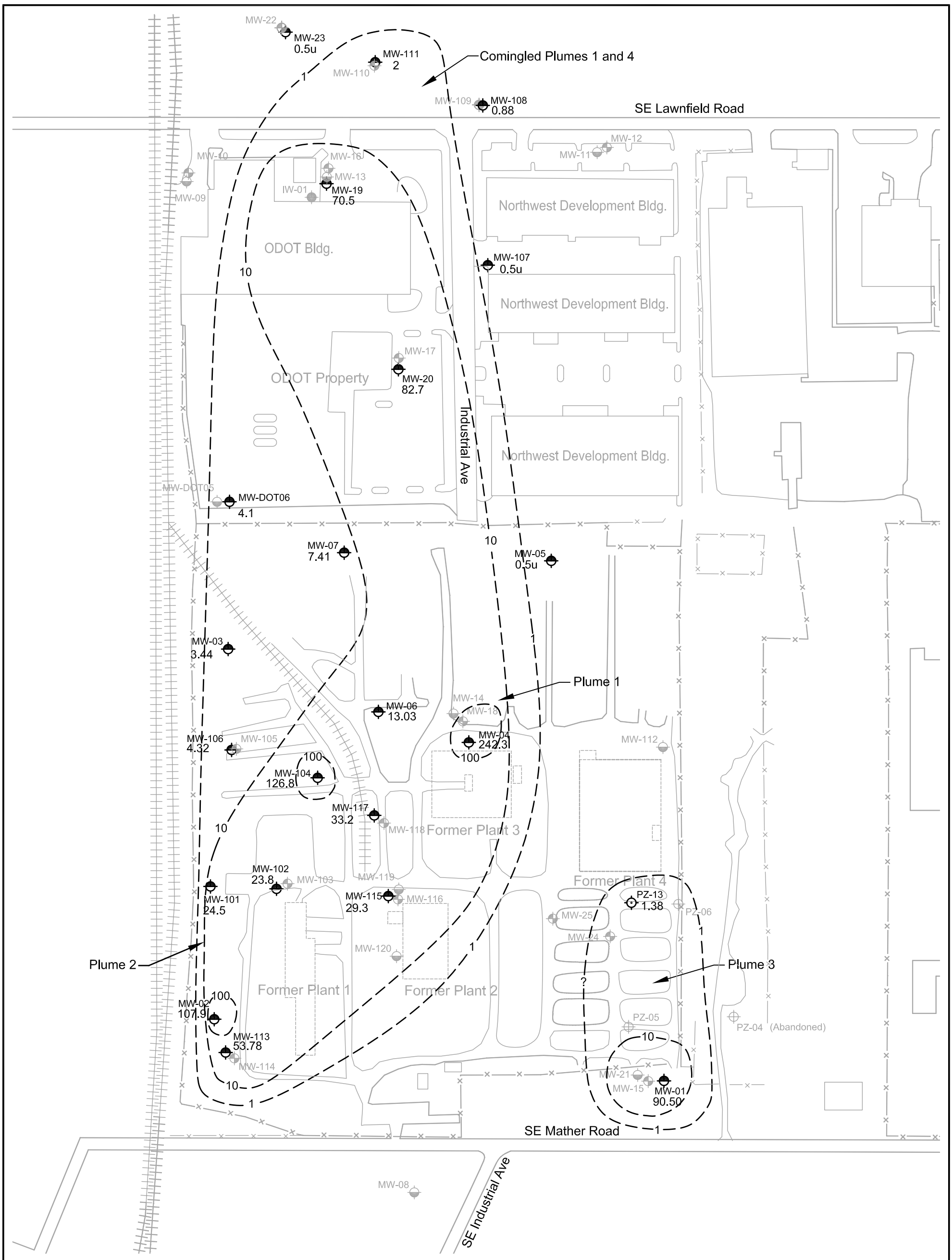

LEGEND

- Shallow Upper Aquifer Well (0-20 feet bgs)
- Intermediate Upper Aquifer Well (20-60 feet bgs)
- Lower Upper Aquifer Well (60-110 feet bgs)
- Lower Aquifer Well (115 feet bgs)
- Shallow Upper Aquifer Piezometer (0-20 feet bgs)
- Intermediate Upper Aquifer Piezometer (20-60 feet bgs)

Groundwater Concentration & Contour Interval
Units in ug/L.

Figure 6
Total COC
(PCE, TCE, Vinyl Chloride)
Plume Boundary
Shallow Upper Aquifer

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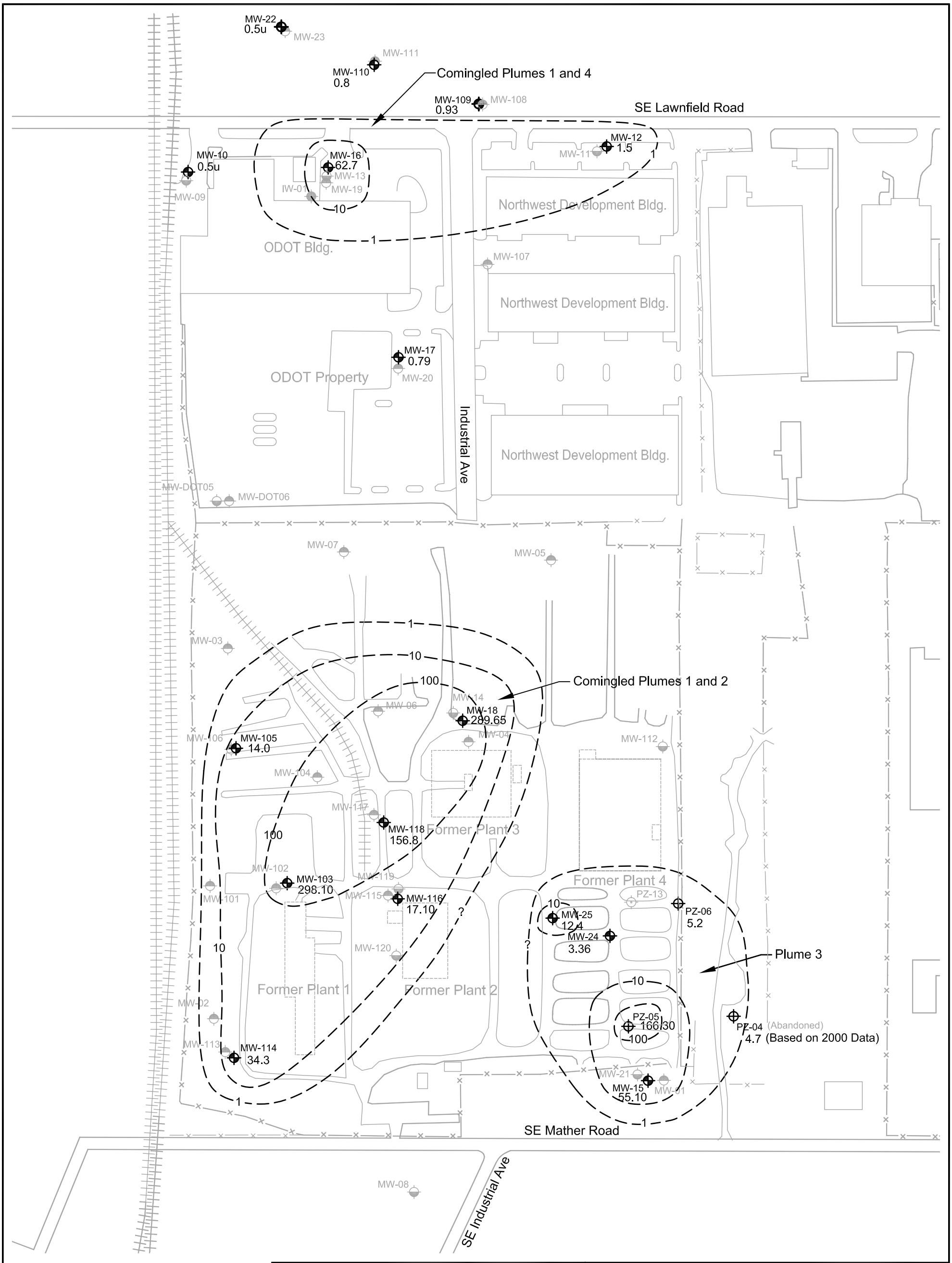
MW-22
0.5u
MW-23
MW-111
MW-110
0.8
Comingled Plumes 1 and 4
MW-109
0.93
MW-108
SE Lawnfield Road
MW-12
1.5
MW-11
MW-10
0.5u
MW-16
62.7
MW-13
MW-19
IW-01
MW-09
10
1
ODOT Bldg.
Northwest Development Bldg.
MW-107
Northwest Development Bldg.
MW-17
0.79
ODOT Property
MW-20
Industrial Ave
Northwest Development Bldg.
MW-DOT05
MW-DOT06
MW-07
MW-05
1
10
100
Comingled Plumes 1 and 2
MW-03
MW-14
MW-06
MW-18
289.65
MW-04
MW-112
MW-106
MW-105
14.0
MW-104
MW-117
MW-118
156.8
Former Plant 3
100
MW-102
MW-103
298.10
MW-119
Former Plant 4
PZ-13
MW-101
MW-115
MW-116
17.10
?
10
MW-25
12.4
PZ-06
5.2
MW-24
3.36
?
Plume 3
MW-120
10
Former Plant 1
Former Plant 2
MW-02
PZ-05
166.30
100
PZ-04 (Abandoned)
4.7 (Based on 2000 Data)
MW-113
MW-114
34.3
MW-21
MW-15
55.10
MW-01
1
1
SE Mather Road
MW-08
SE Industrial Ave
PLANT NORTH
19°
0 50 100 200
SCALE IN FEET
LEGEND
Shallow Upper Aquifer Well (0-20 feet bgs)
Intermediate Upper Aquifer Well (20-60 feet bgs)
Lower Upper Aquifer Well (60-110 feet bgs)
Lower Aquifer Well (115 feet bgs)
Shallow Upper Aquifer Piezometer (0-20 feet bgs)
Intermediate Upper Aquifer Piezometer (20-60 feet bgs)
Groundwater Concentration & Contour Interval
Units in ug/L.
Figure 7
Total COC
(PCE, TCE, Vinyl Chloride)
Plume Boundary
Intermediate Upper Aquifer
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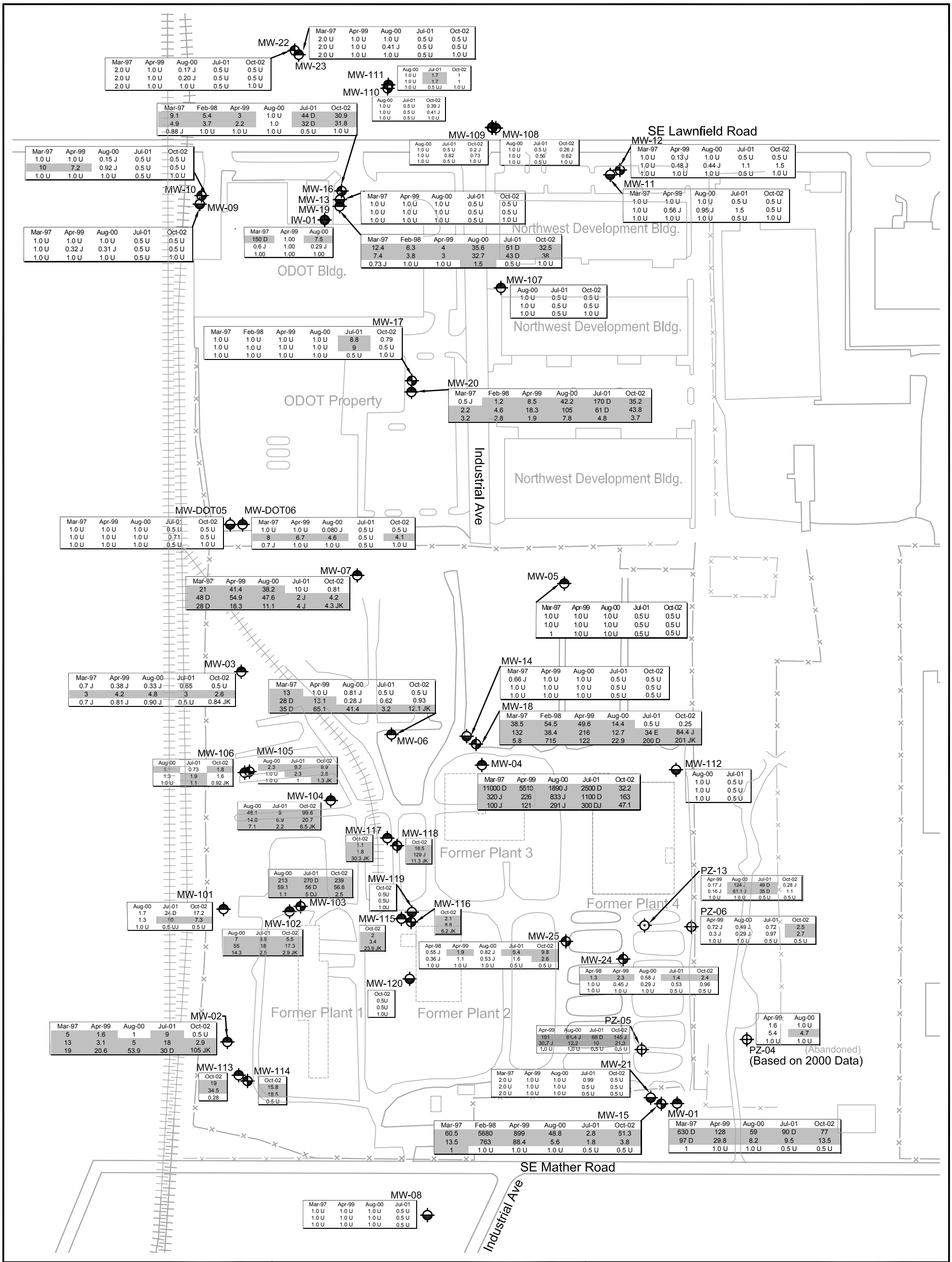

VOC Concentrations in Groundwater

MW-103	Aug-00	Jul-01	Oct-02
PCE	213	270 D	239
TCE	59.1	56 D	56.6
VC	1.1	5 DJ	2.5

Sampling Year Concentrations (ug/L)

Remedial Action Objectives

PCE	1.0 ug/L
TCE	1.6 ug/L
Vinyl Chloride	1.0 ug/L

Note: Shaded values exceed the Remediation Goals.

PLANT NORTH

19°

0 50 100 200

SCALE IN FEET

LEGEND

- Shallow Upper Aquifer Well (0-20 feet bgs)
- Intermediate Upper Aquifer Well (20-60 feet bgs)
- Lower Upper Aquifer Well (60-110 feet bgs)
- Lower Aquifer Well (115 feet bgs)
- Shallow Upper Aquifer Piezometer (0-20 feet bgs)
- Intermediate Upper Aquifer Piezometer (20-60 feet bgs)

Figure 8
COC Concentrations in Groundwater (1997-2002)

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Figure 9
MW-04 COC Concentrations
1997 to 2002

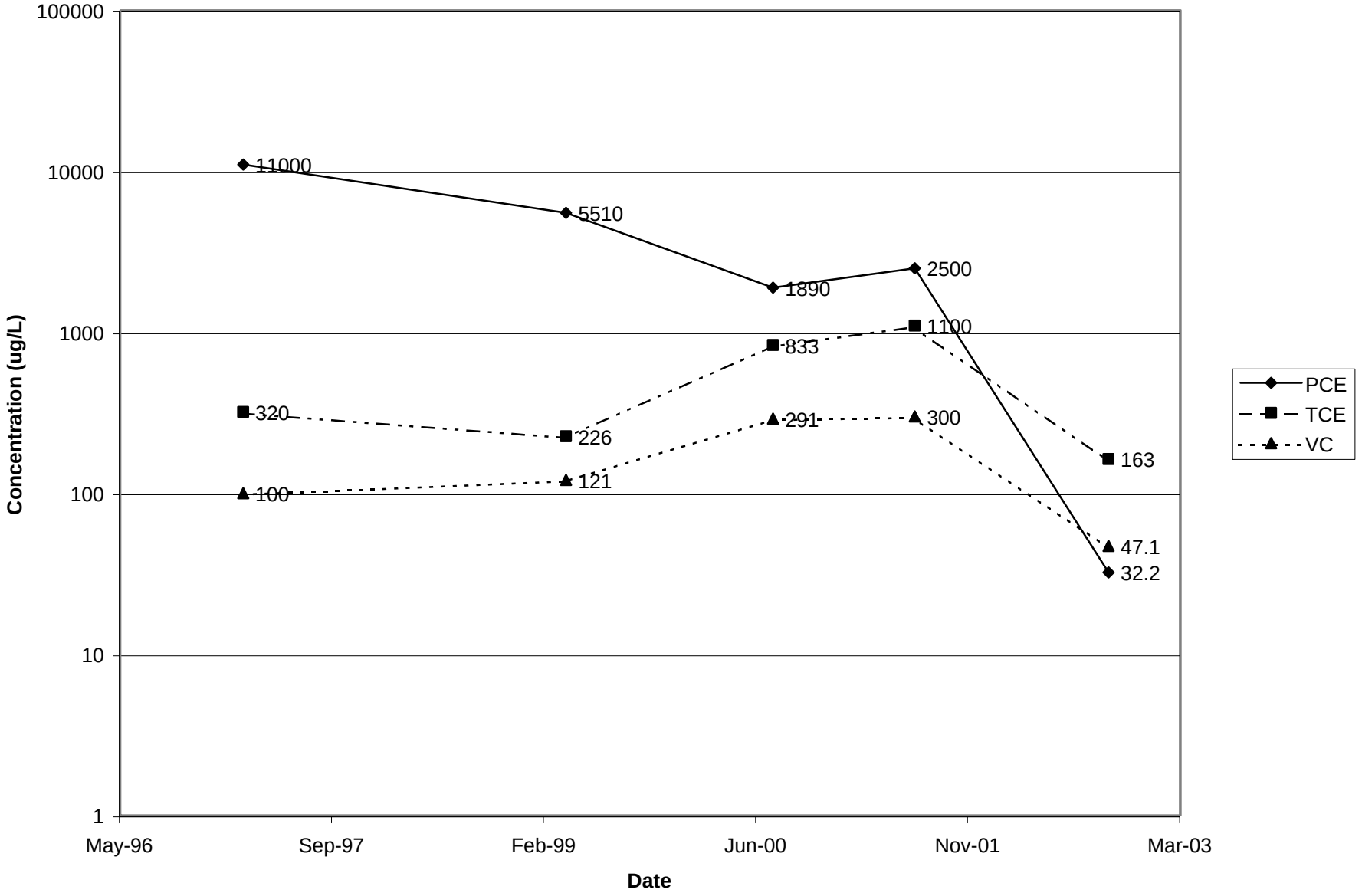
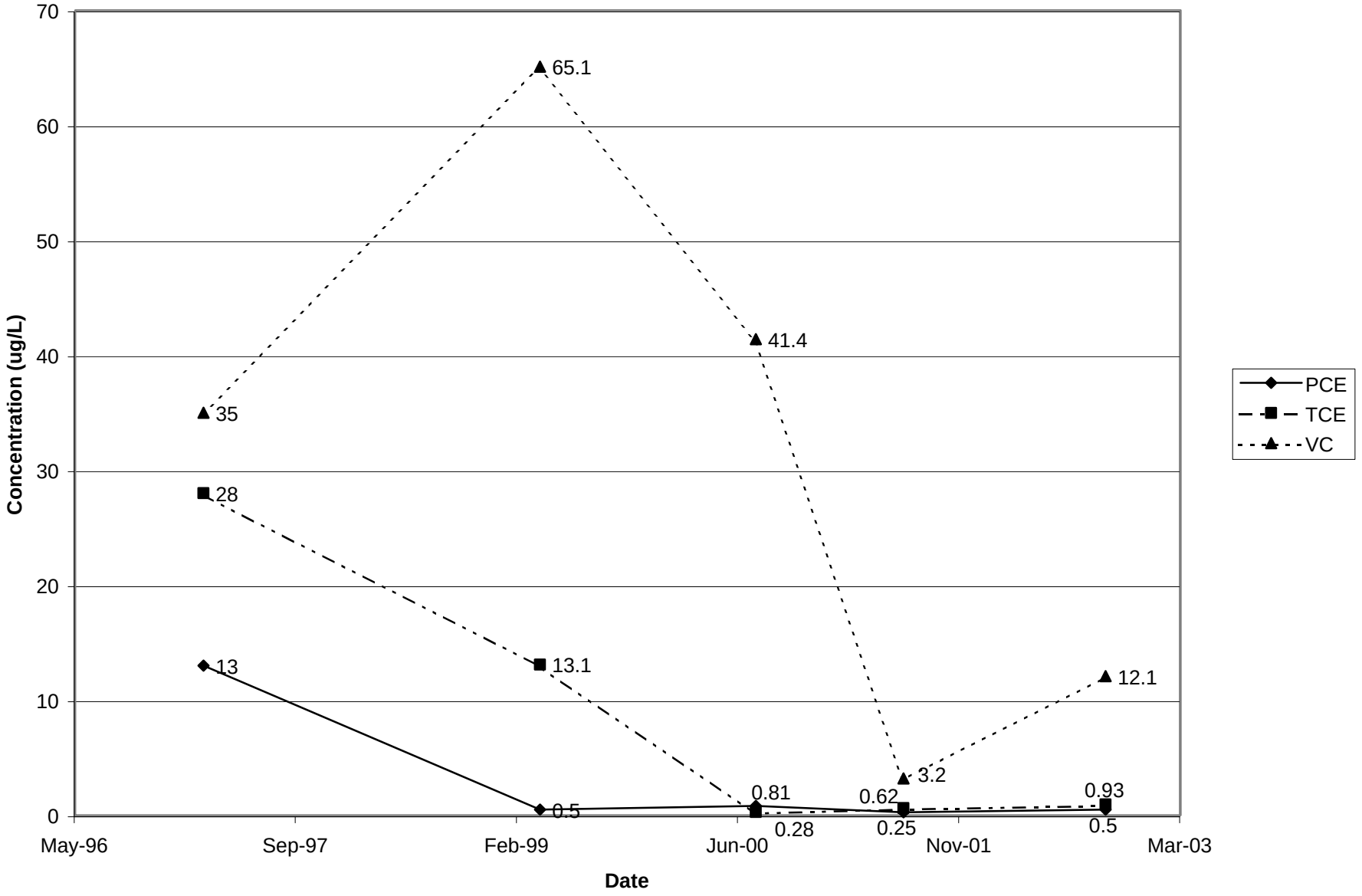
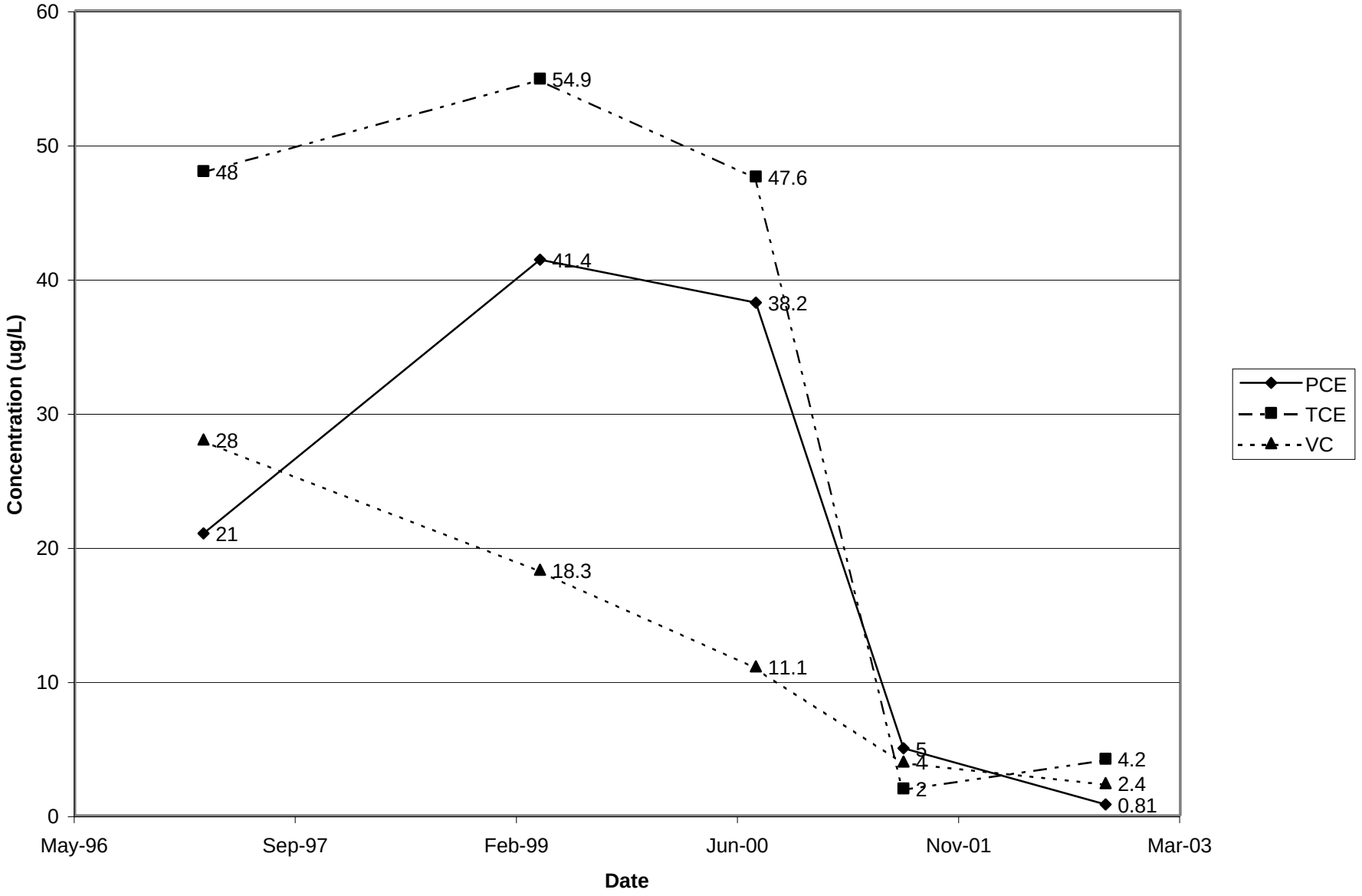


Figure 10
MW-06 COC Concentrations
1997 to 2002



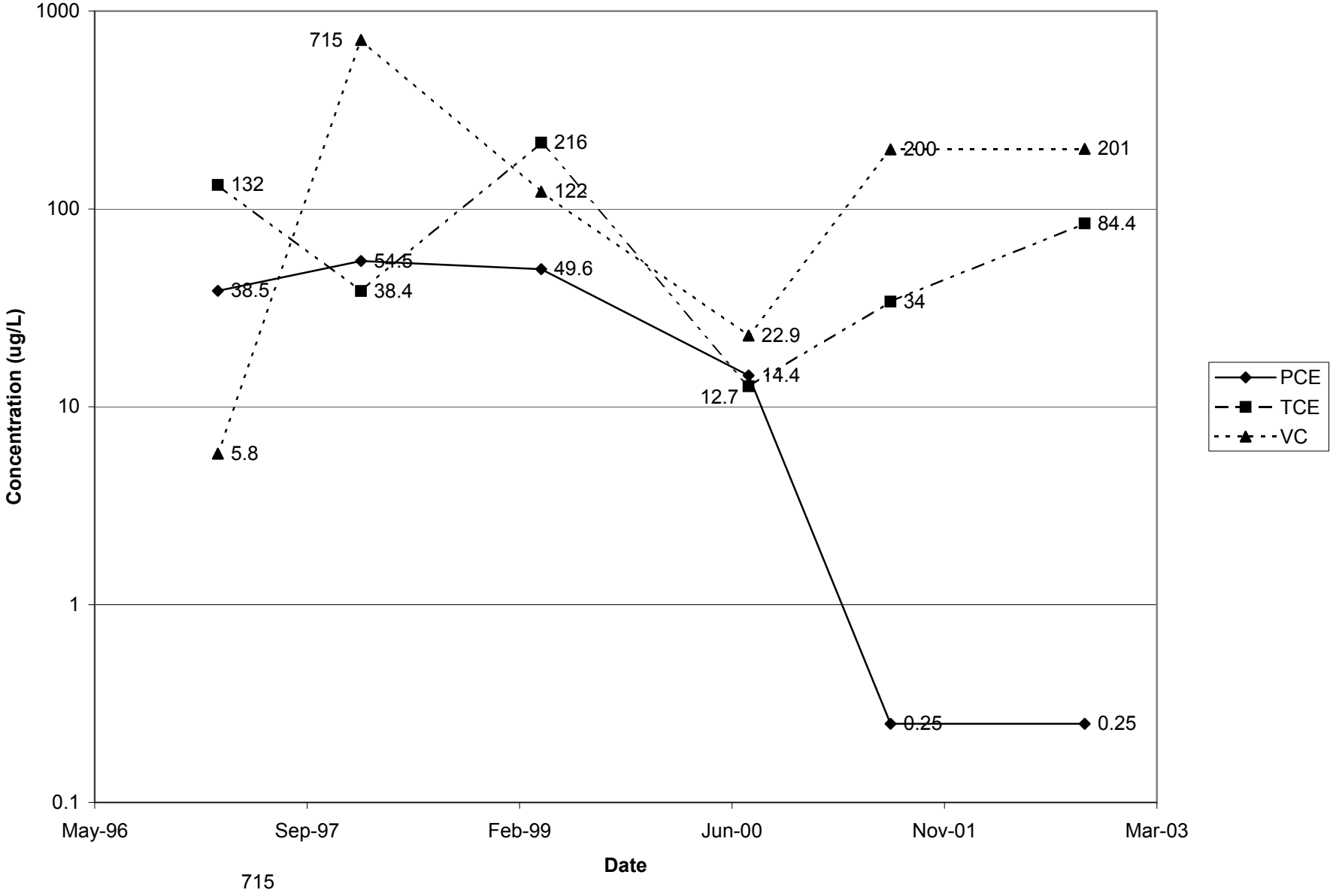
o:53-f4009300.00 NWPC GW RD\GW Tech Memo\2002 data trend.xls MW-6

Figure 11
MW-07 COC Concentrations
1997 to 2002



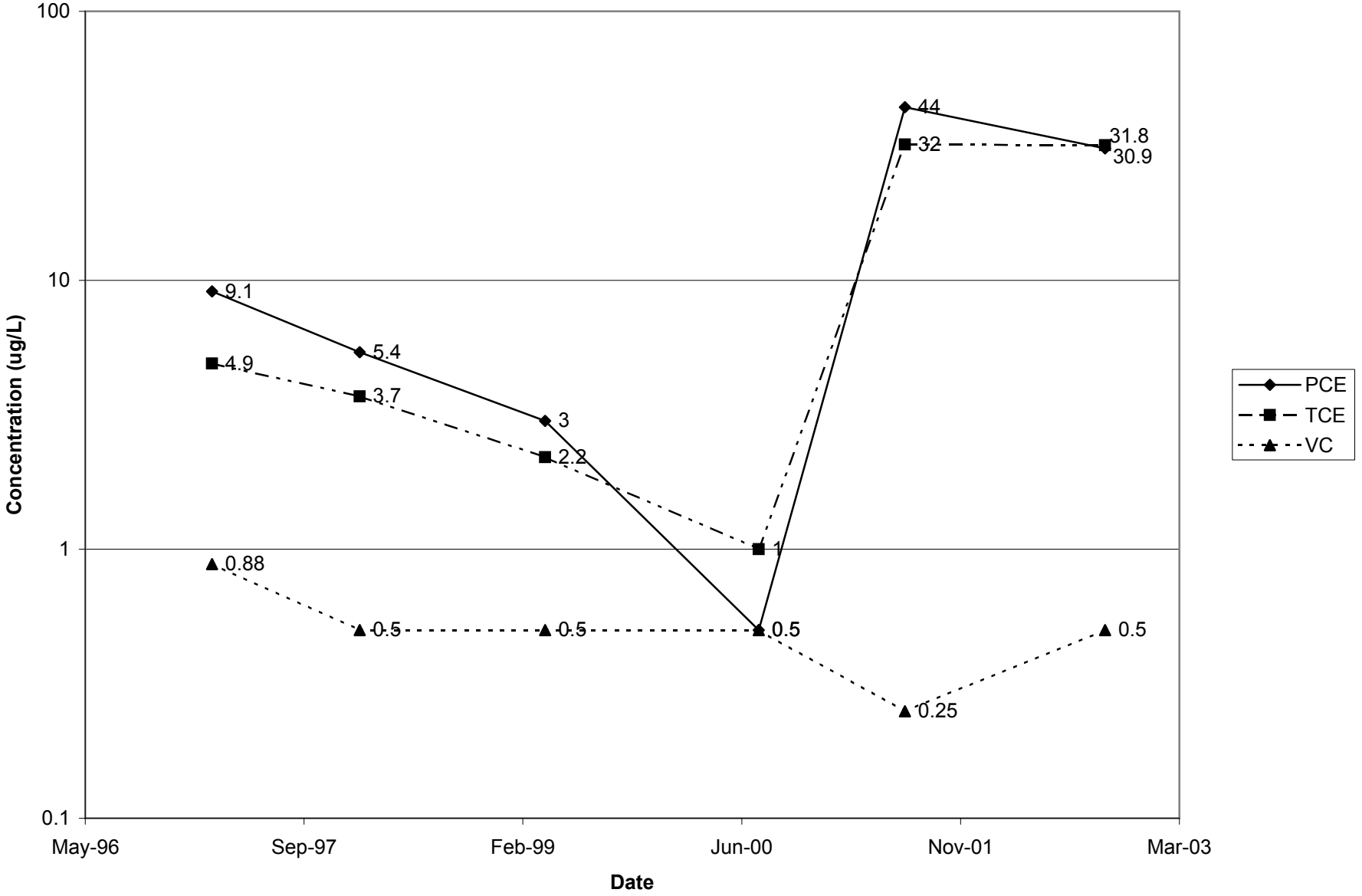
o:53-f4009300.00 NWPC GW RD\GW Tech Memo\2002 data trend.xls MW-7

Figure 12
MW-18 COC Concentrations
1997 to 2002



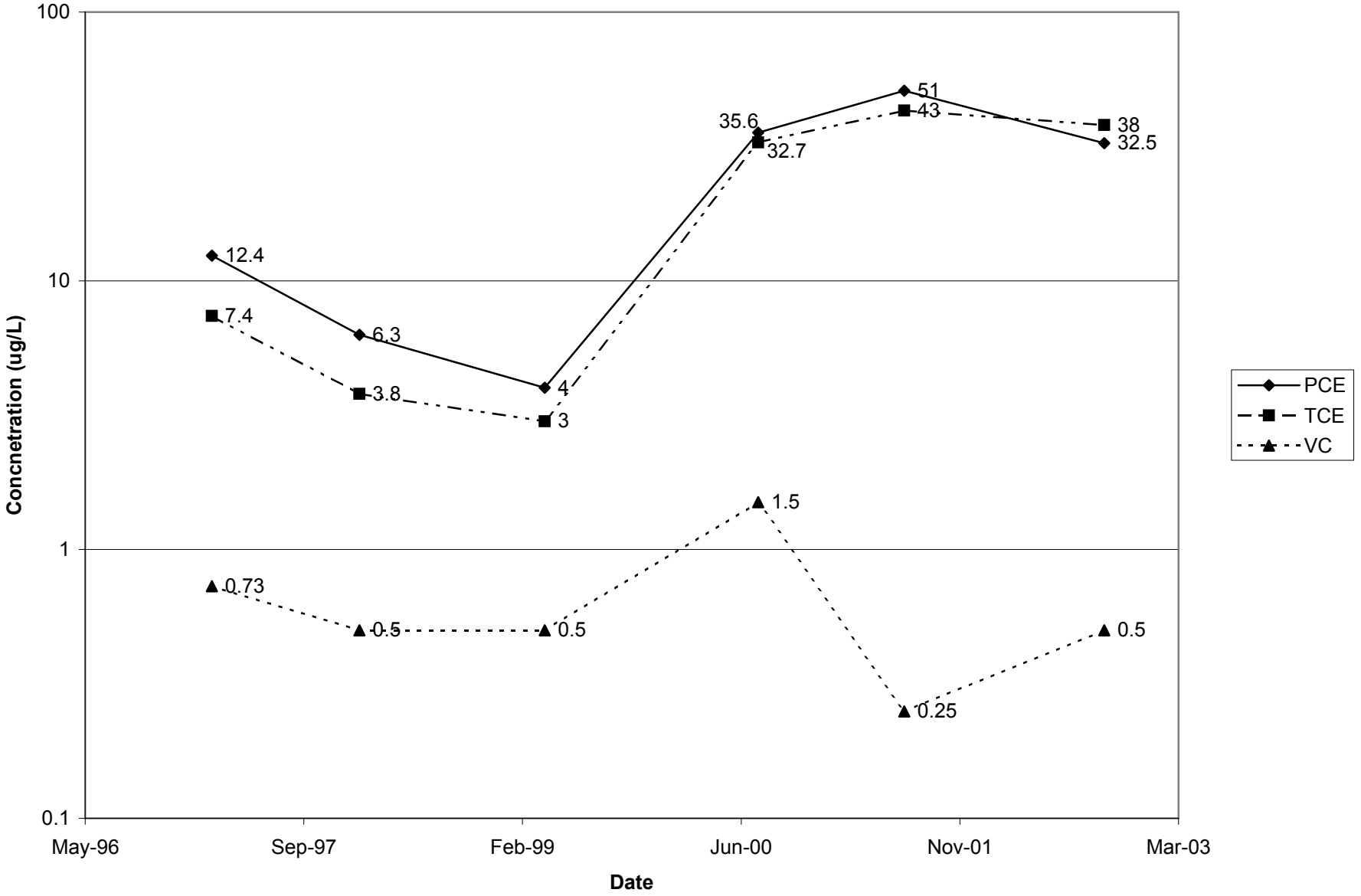
o:53-f4009300.00 NWPC GW RD\GW Tech Memo\2002 data trend.xls MW-18

Figure 13
MW-16 COC Concentrations
1997 to 2002



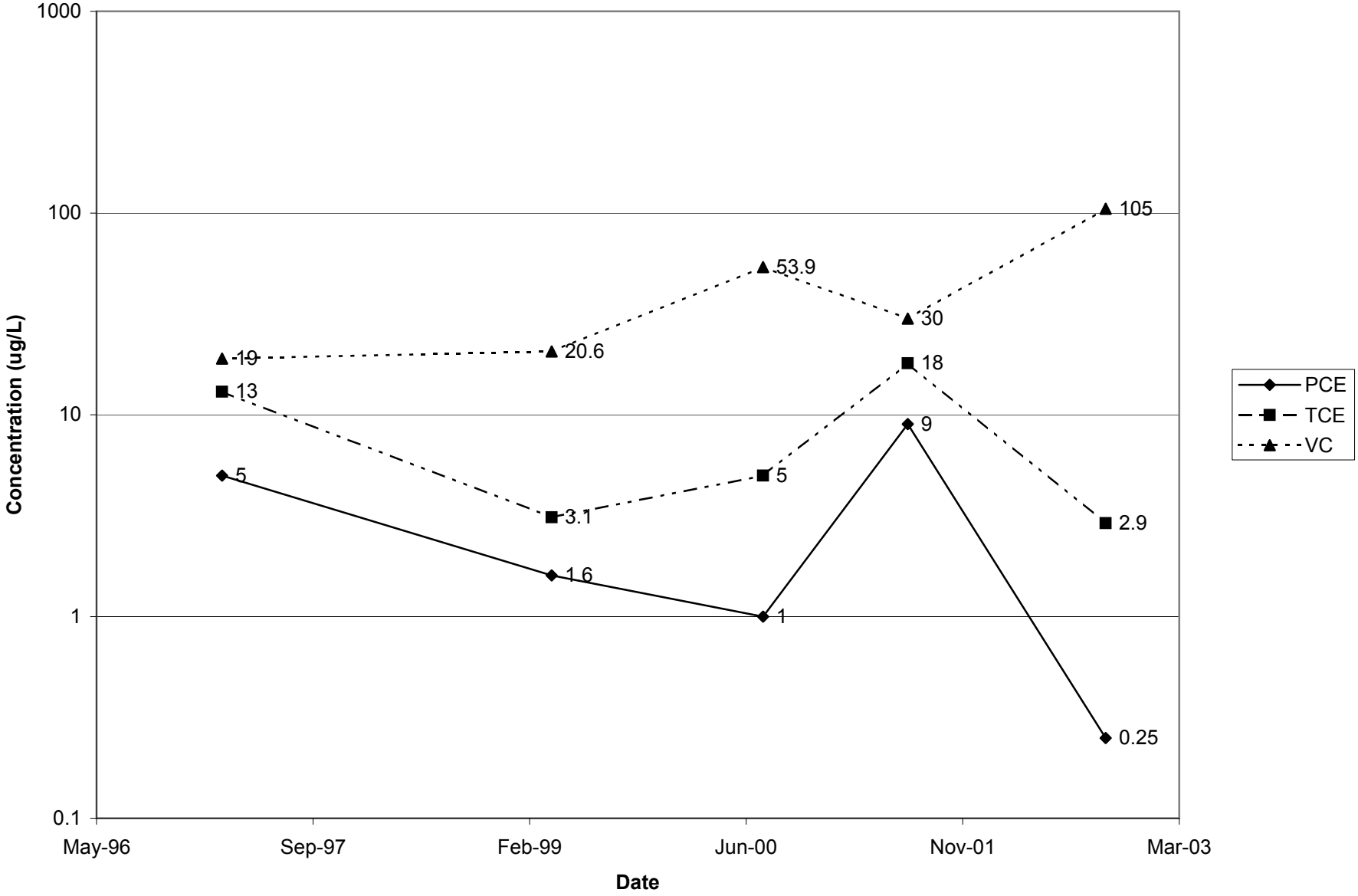
o:53-f4009300.00 NWPC GW RD\GW Tech Memo\2002 data trend.xls MW-16

Figure 14
MW-19 COC Concentrations
1997 to 2002



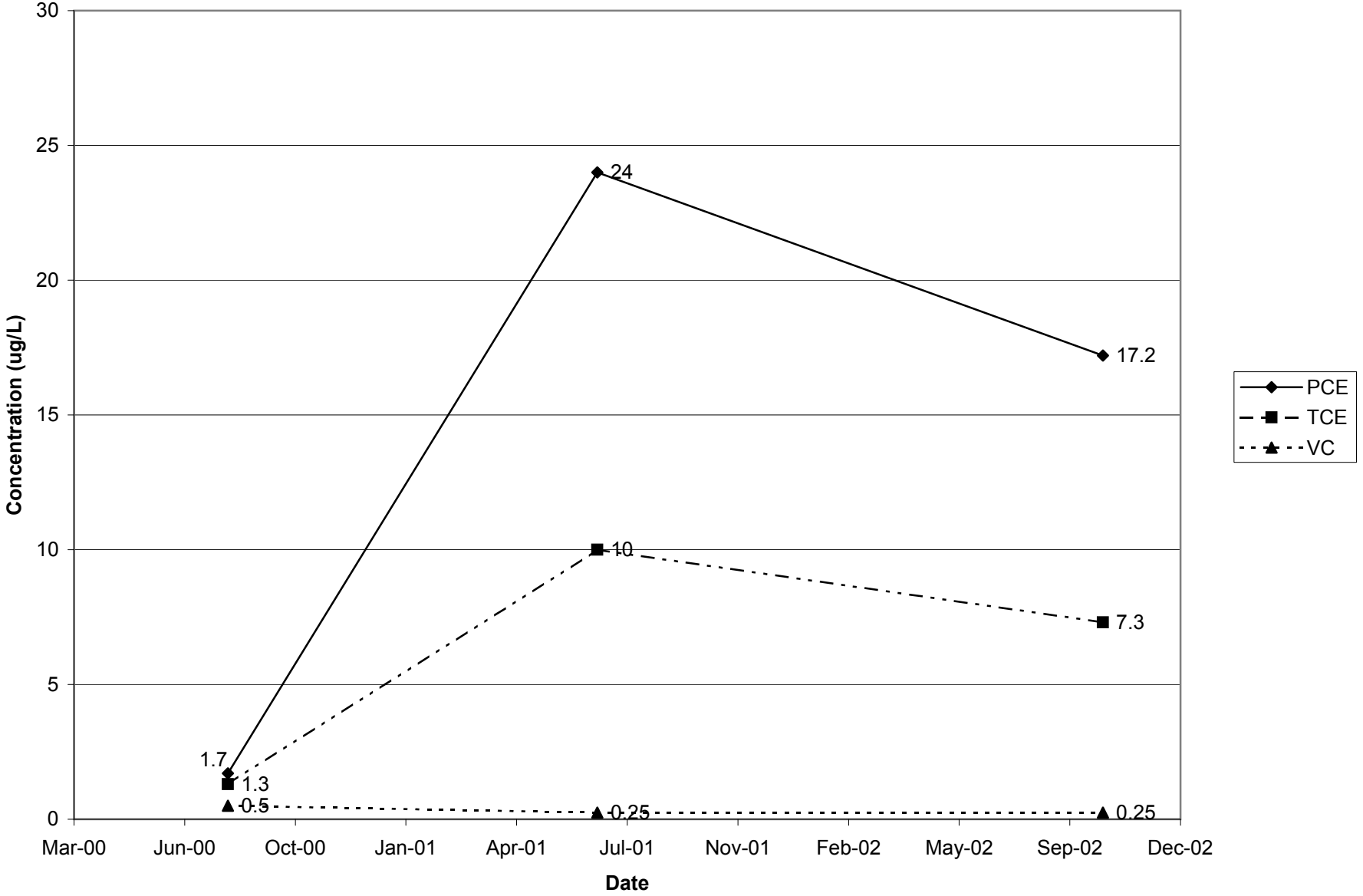
o:53-f4009300.00 NWPC GW RD\GW Tech Memo\2002 data trend.xls MW-19

Figure 15
MW-02 COC Concentrations
1997 to 2002



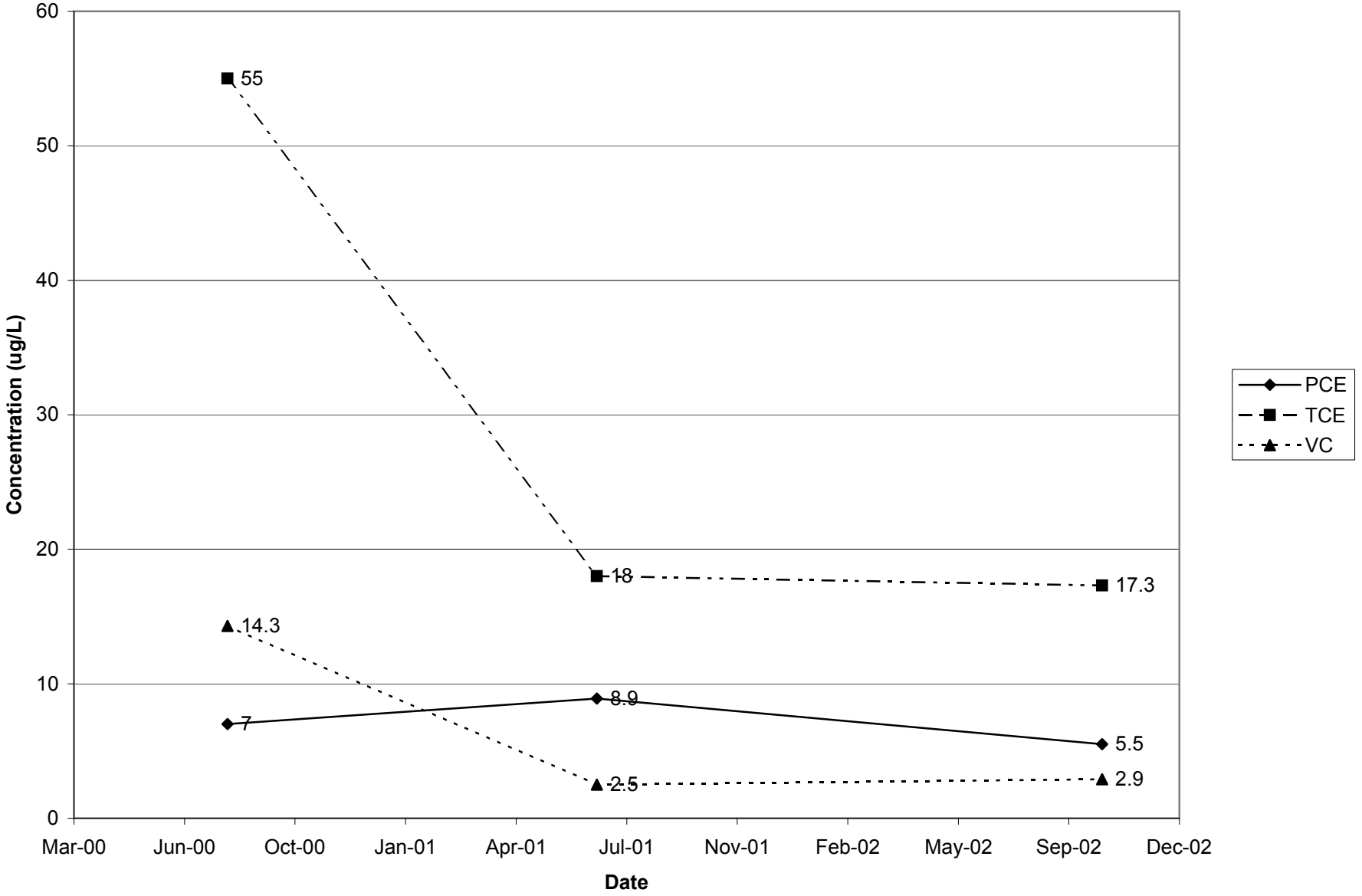
o:53-f4009300.00 NWPC GW RD\GW Tech Memo\2002 data trend.xls MW-2

Figure 16
MW-101 COC Concentrations
2000 to 2002



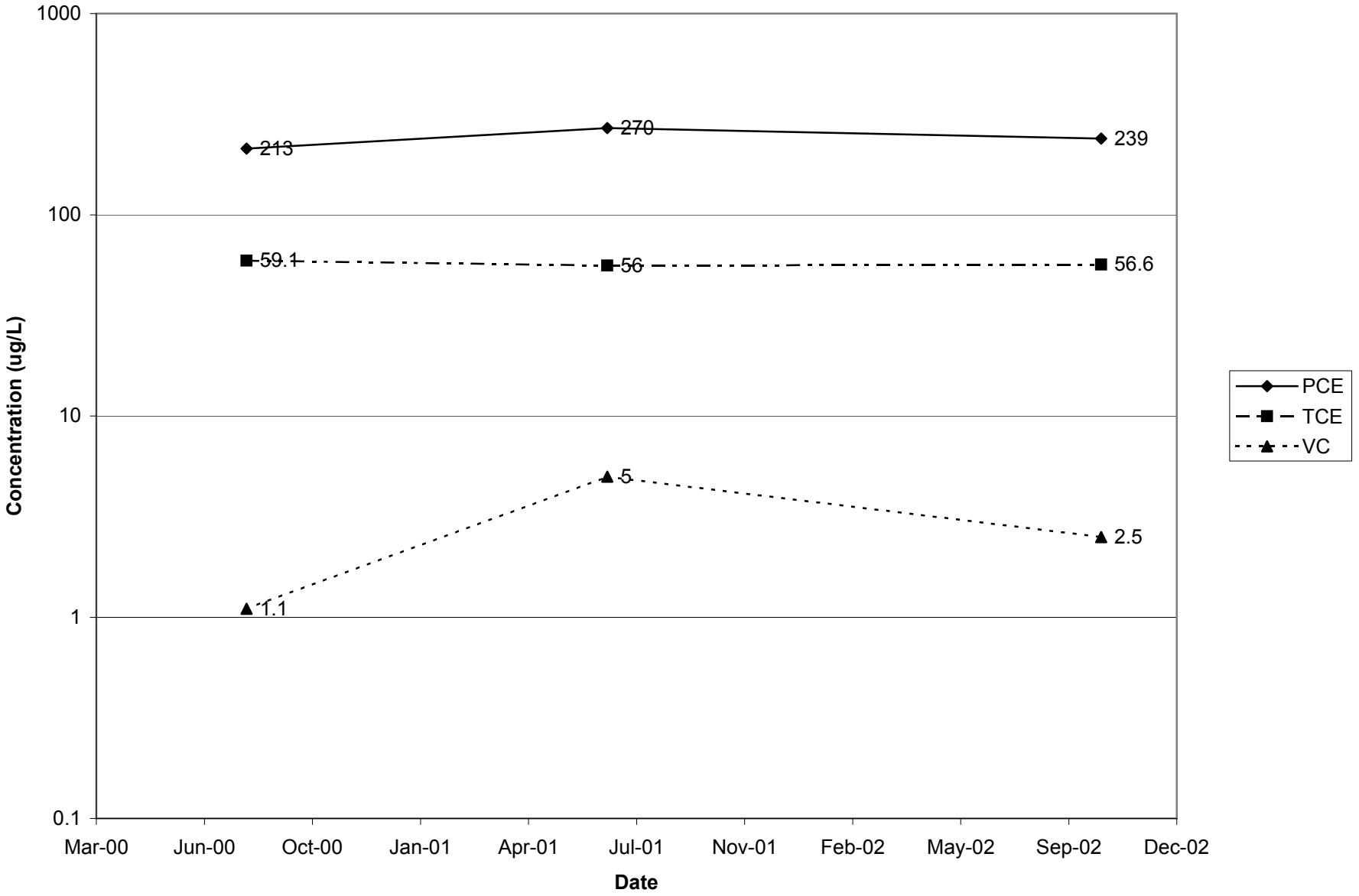
o:53-f4009300.00 NWPC GW RD\GW Tech Memo\2002 data trend.xls MW-101

Figure 17
MW-102 COC Concentrations
2000 to 2002



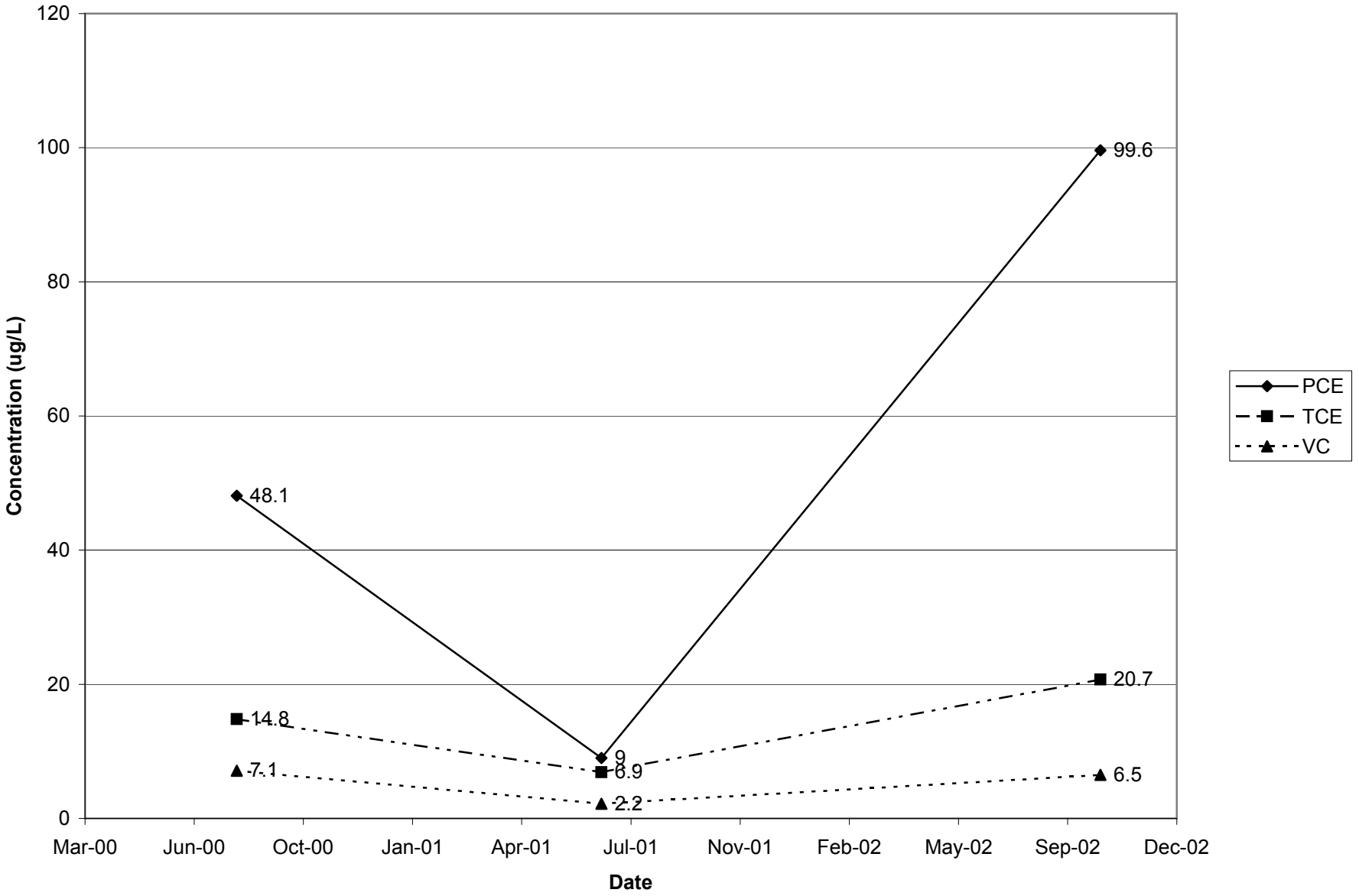
o:53-f4009300.00 NWPC GW RD\GW Tech Memo\2002 data trend.xls MW-102

Figure 18
MW-103 COC Concentrations
2000 to 2002



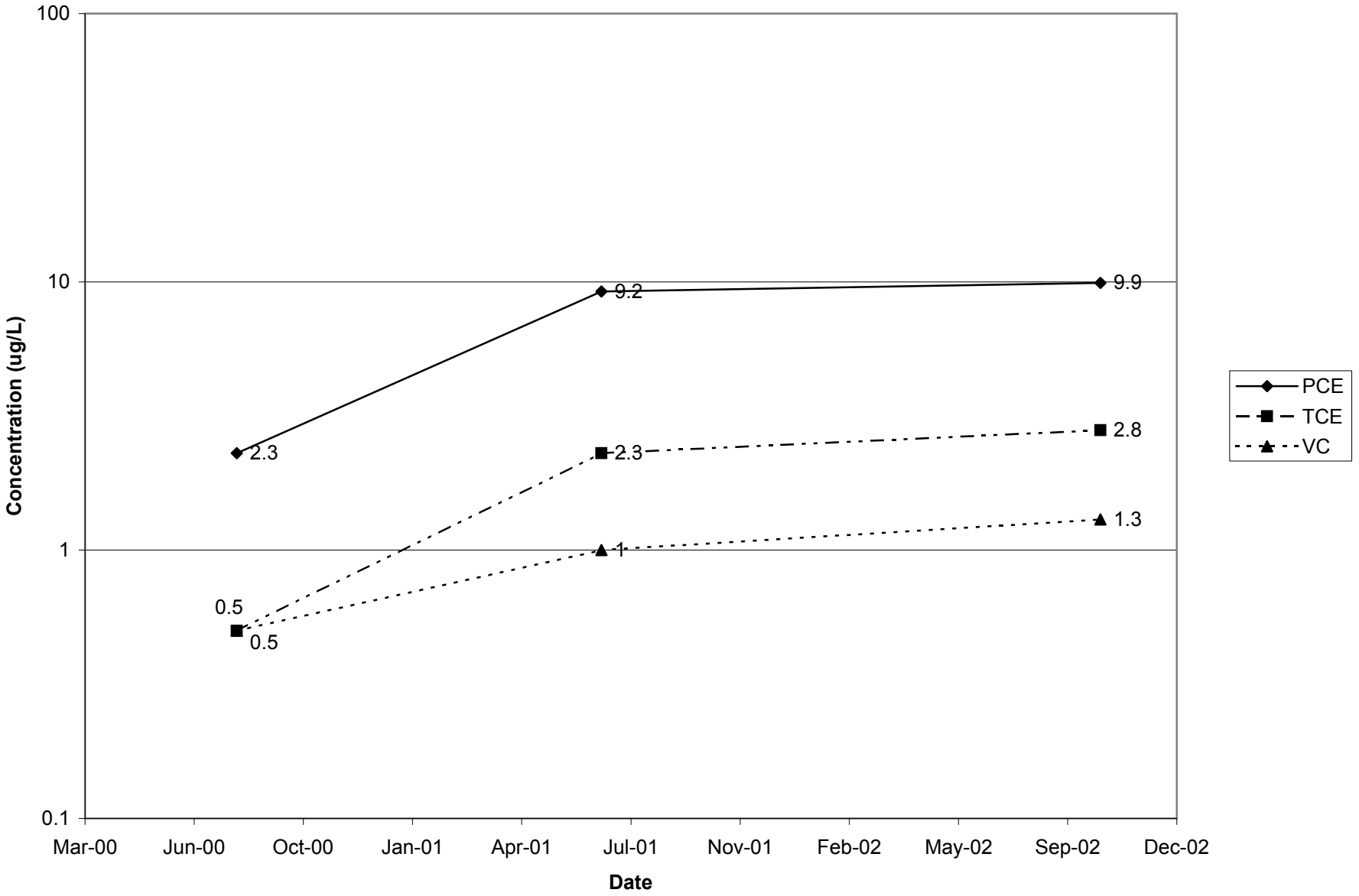
o:53-f4009300.00 NWPC GW RD\GW Tech Memo\2002 data trend.xls MW-103

Figure 19
MW-104 COC Concentrations
2000 to 2002



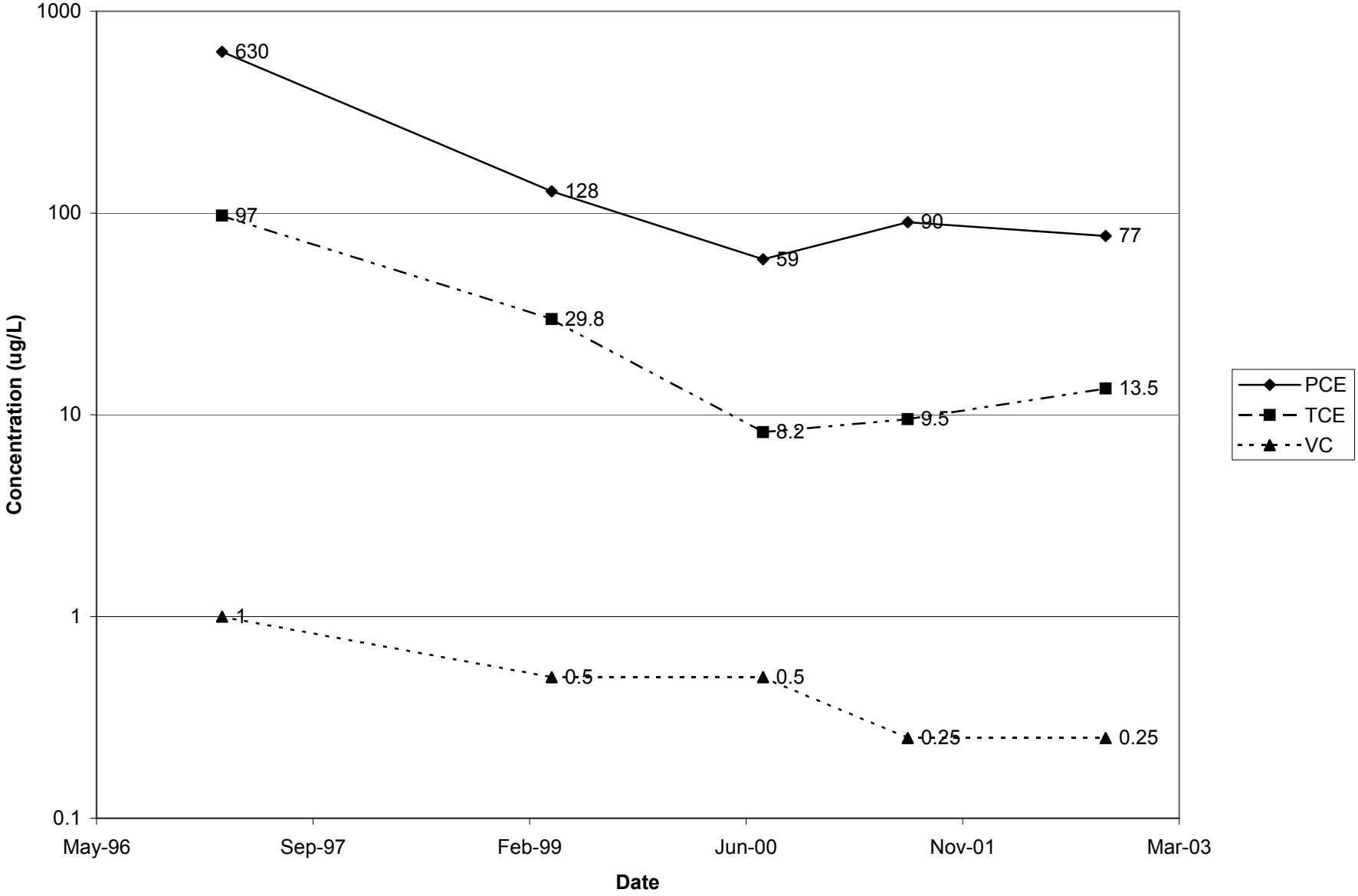
o:53-f4009300.00 NWPC GW RD\GW Tech Memo\2002 data trend.xls MW-104

Figure 20
MW-105 COC Concentrations
2000 to 2002



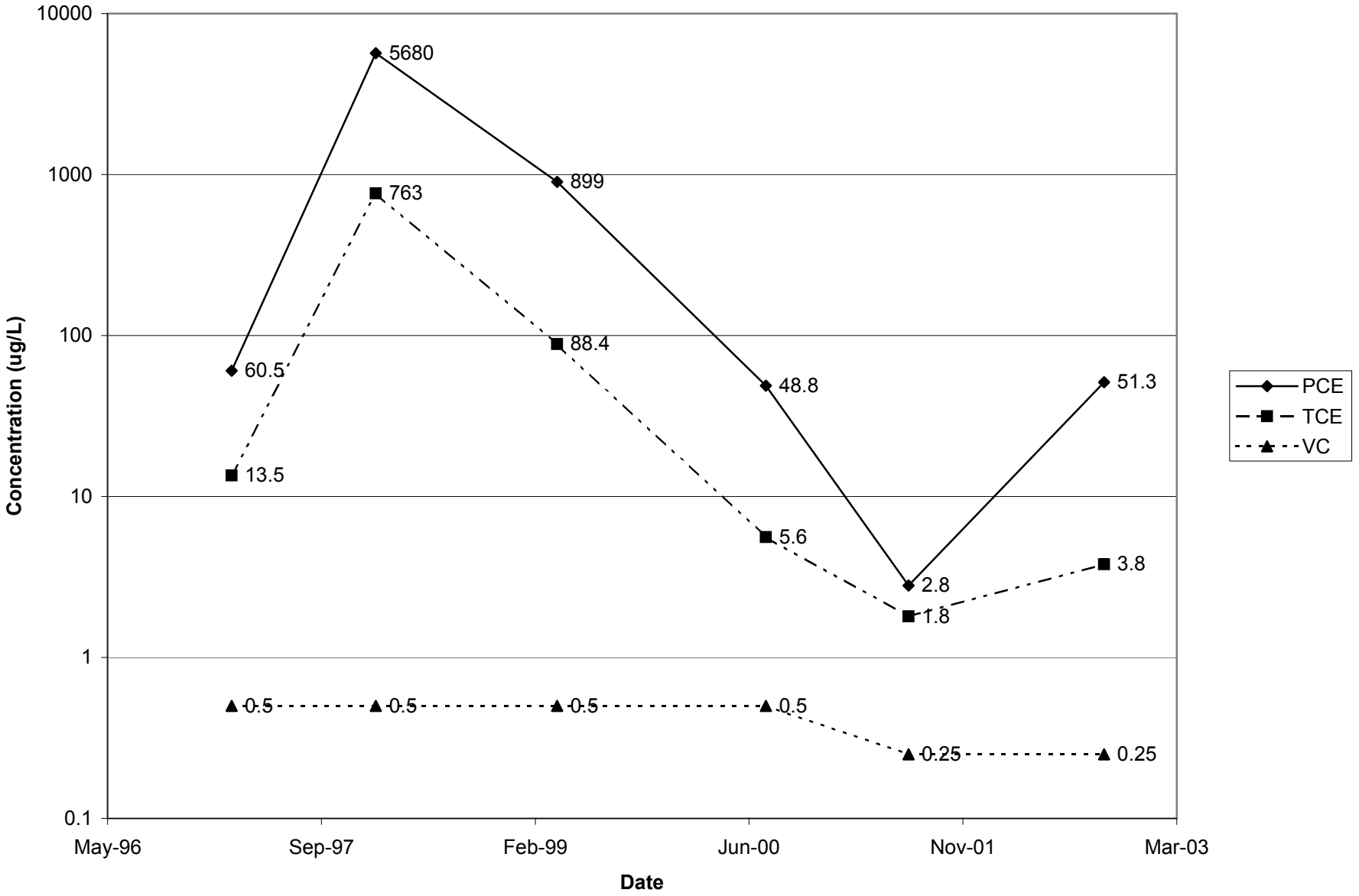
o:53-f4009300.00 NWPC GW RD\GW Tech Memo\2002 data trend.xls MW-105

Figure 21
MW-01 COC Concentrations
1997 to 2002



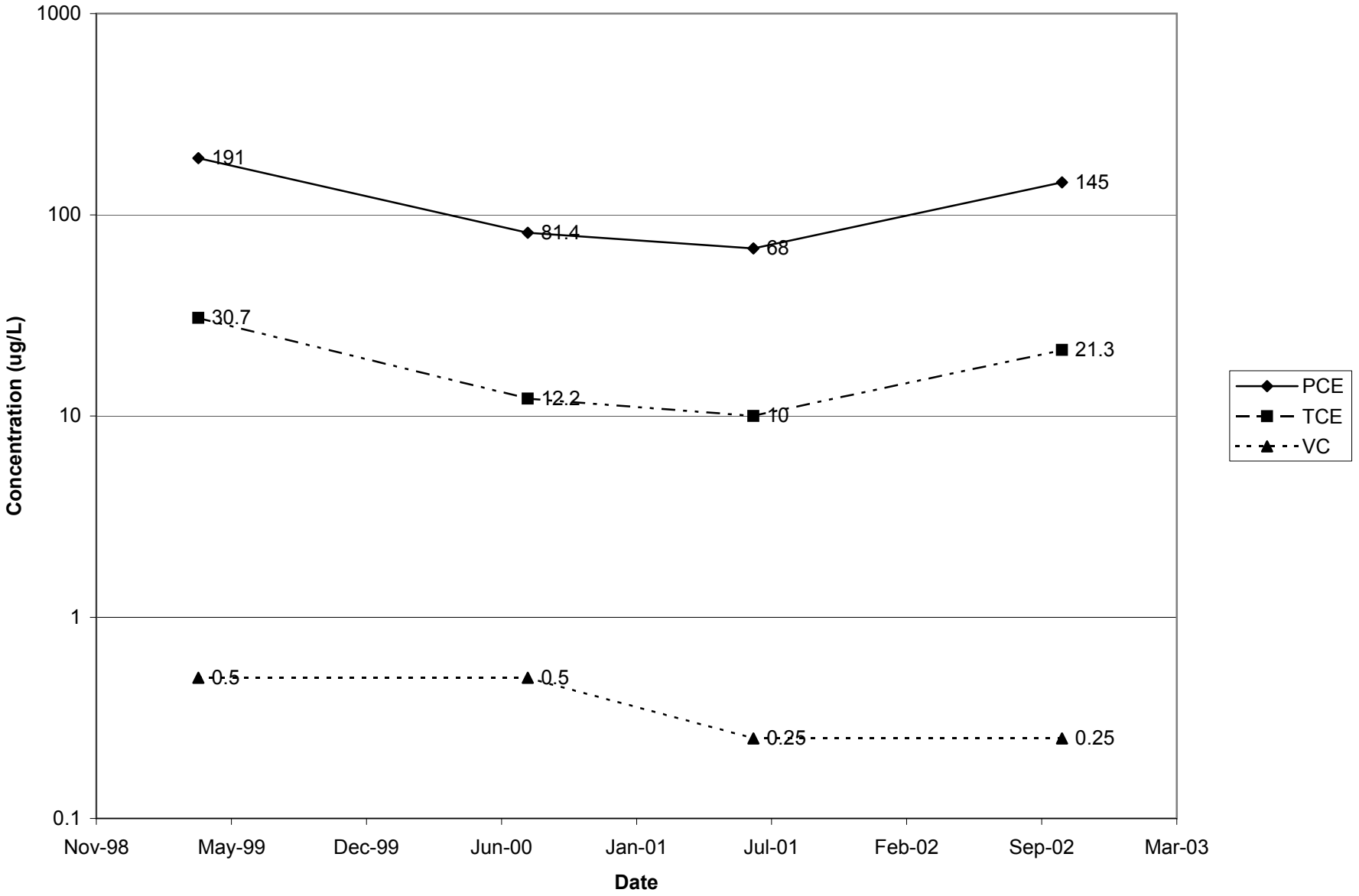
o:53-f4009300.00 NWPC GW RD\GW Tech Memo\2002 data trend.xls MW-1

Figure 22
MW-15 COC Concentrations
1997 to 2002



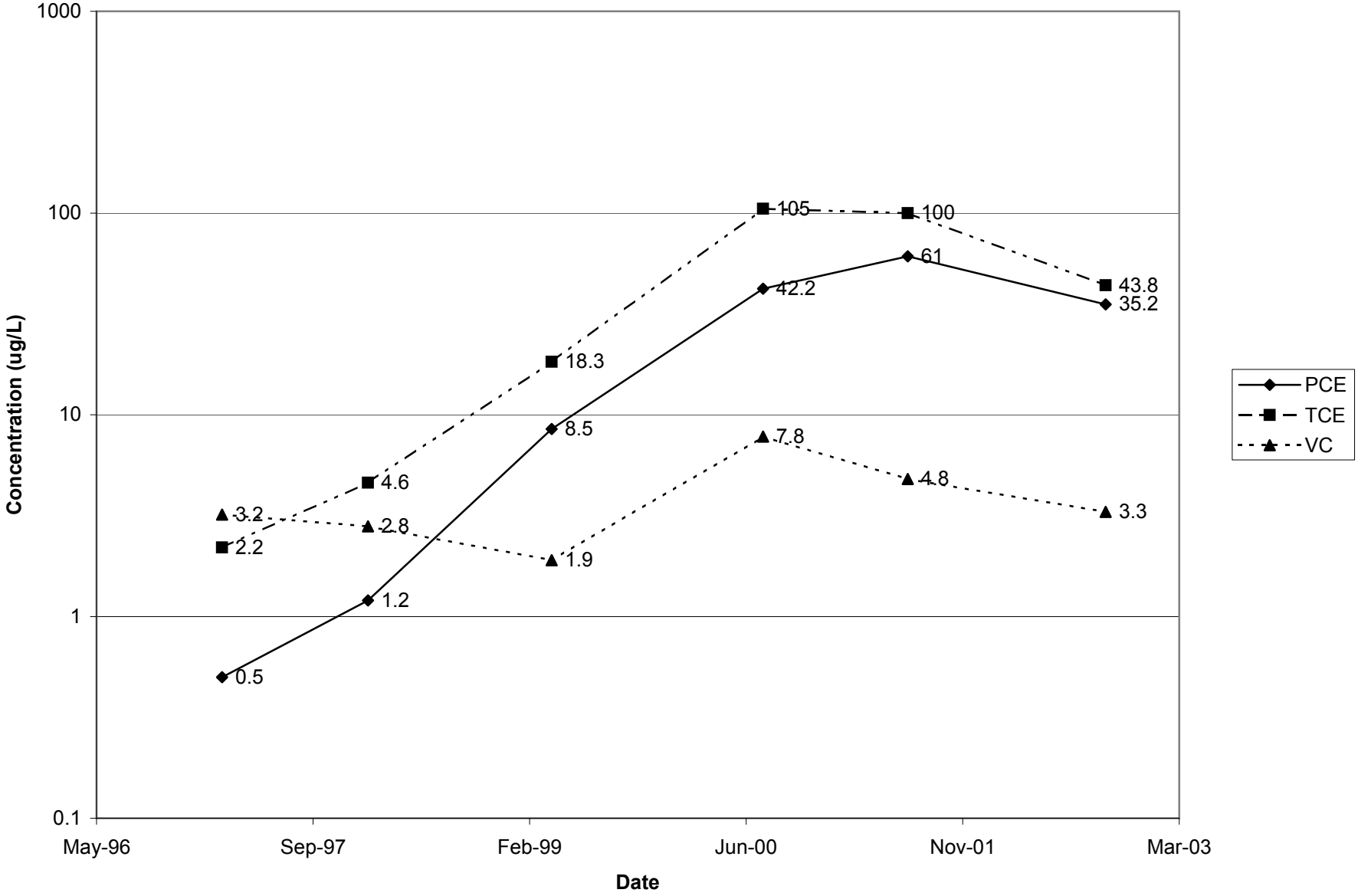
o:53-f4009300.00 NWPC GW RD\GW Tech Memo\2002 data trend.xls MW-15

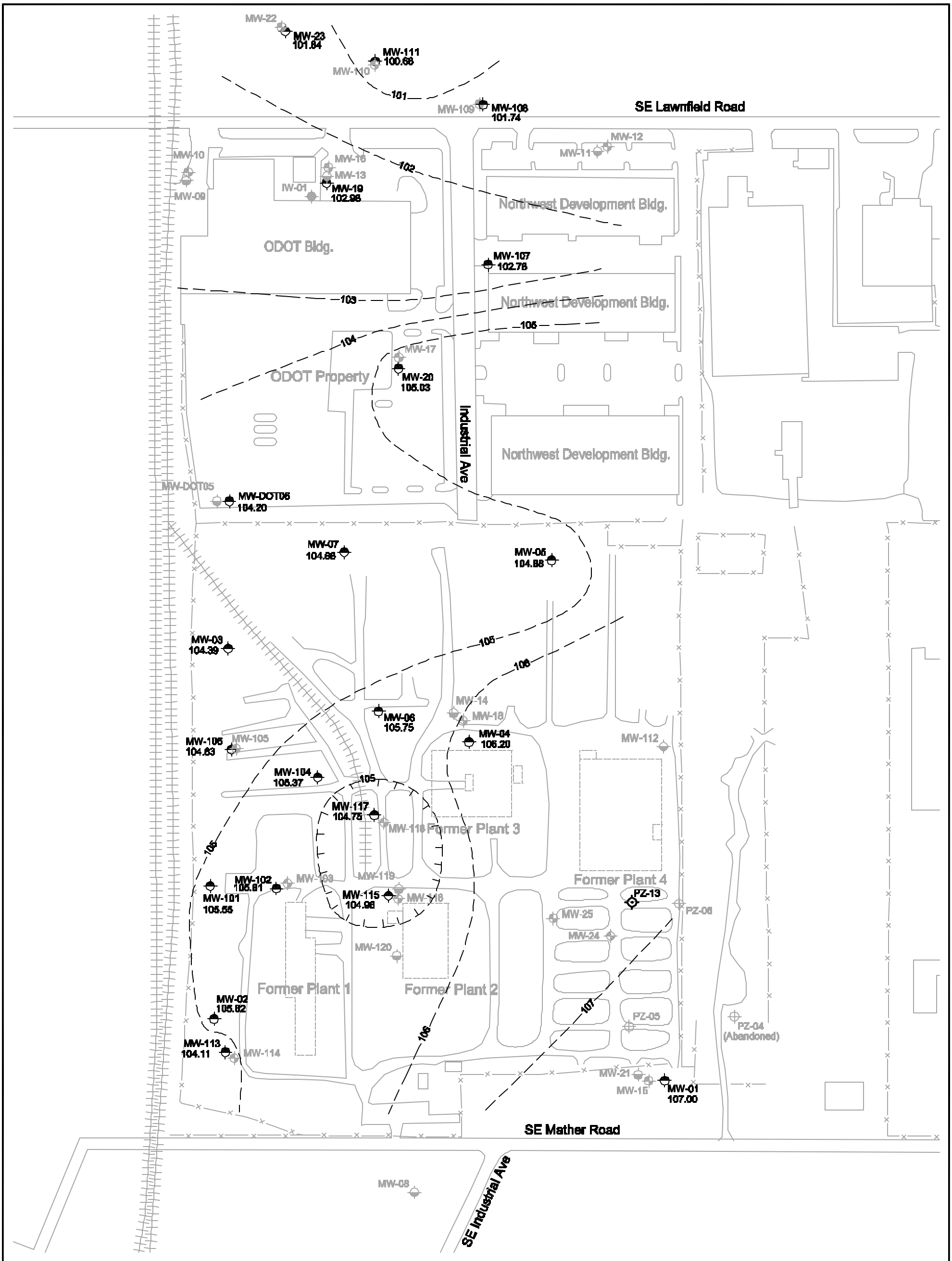
Figure 23
PZ-05 COC Concentrations
1999 to 2002



o:53-f4009300.00 NWPC GW RD\GW Tech Memo\2002 data trend.xls PZ-5

Figure 24
MW-20 COC Concentrations
1997 to 2002





LEGEND

- Shallow Upper Aquifer Well (0-20 feet bgs)
- Intermediate Upper Aquifer Well (20-60 feet bgs)
- Lower Upper Aquifer Well (60-110 feet bgs)
- Lower Aquifer Well (115 feet bgs)
- Shallow Upper Aquifer Piezometer (0-20 feet bgs)
- Intermediate Upper Aquifer Piezometer (20-60 feet bgs)

Groundwater Elevations & Contours are in feet NGVD.

Figure 25
Fall 2002 Groundwater Elevations and Contours (Shallow Upper Aquifer)

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TABLES

TABLE 1
Well Construction Details

Location ID	Location	Total Depth (feet bgs)	Aquifer Level	Top of Screen Depth (feet bgs)	Bottom of Screen Depth (feet bgs)	Screen Length (feet)	Screen Slot Size (inches)	Well Diameter (Inches)	Casing Material
MW-113	Downgradient of Drum Burial Area	20	Shallow Upper	15	20	5	0.020	2	Sch 40 PVC
MW-114	Downgradient of Excavation Area 2	40	Intermediate Upper	35	40	5	0.020	2	Sch 40 PVC
MW-115	Downgradient of Slotted Tank	20	Shallow Upper	15	20	5	0.020	2	Sch 40 PVC
MW-116	Downgradient of Slotted Tank	40	Intermediate Upper	35	40	5	0.020	2	Sch 40 PVC
MW-117	Downgradient of Slotted Tank	20	Shallow Upper	15	20	5	0.020	2	Sch 40 PVC
MW-118	Downgradient of Slotted Tank	40	Intermediate Upper	35	40	5	0.020	2	Sch 40 PVC
MW-119	Downgradient of Slotted Tank	20	Deep Upper	102	112	10	0.020	2	Sch 40 PVC
MW-120	At Slotted Tank	40	Deep Upper	95	105	10	0.020	2	Sch 40 PVC

bgs - Below Ground Surface

TABLE 2
Groundwater Sampling Locations

Station ID	VOCs	Ryznar Parameters[a]	PDSB	Low-Flow	Field Measurements[b]	Water Level	No. of PDSBs	QA/QC
PZ-05	x			x	x	x	NA	
PZ-06	x			x	x	x	NA	DUP
PZ-13	x			x	x	x	NA	
MW-DOT5	x		x			x	1	
MW-DOT6	x		x			x	1	DUP
MW-01	x		x			x	1	
MW-02	x		x			x	1	
MW-03	x		x			x	1	
MW-04	x	x	x	x	x	x	1	
MW-05	x		x			x	1	
MW-06	x		x			x	1	MS/MSD
MW-07	x		x			x	1	
MW-08	x		x			x	1	
MW-09	x		x			x	1	
MW-10	x		x			x	1	
MW-11	x		x			x	1	
MW-12	x		x			x	1	
MW-13	x		x			x	1	
MW-14	x		x			x	1	DUP
MW-15	x	x	x	x	x	x	1	DUP/MS[c]
MW-16	x		x			x	1	
MW-17	x		x			x	1	
MW-18	x		x			x	1	
MW-19	x		x			x	2	
MW-20	x	x	x	x	x	x	2	
MW-21	x		x			x	2	
MW-22	x		x			x	1	
MW-23	x		x			x	2	
MW-24	x		x			x	1	
MW-25	x		x			x	1	
MW-101	x		x			x	1	
MW-102	x		x			x	1	
MW-103	x	x	x	x	x	x	1	
MW-104	x		x			x	1	MS/MSD
MW-105	x		x			x	1	DUP
MW-106	x		x			x	1	
MW-107	x		x			x	1	DUP
MW-108	x		x			x	1	
MW-109	x		x			x	1	MS/MSD
MW-110	x		x			x	1	
MW-111	x		x			x	1	
MW-113	x		x			x	1	
MW-114	x		x			x	1	
MW-115	x		x			x	1	
MW-116	x		x			x	1	
MW-117	x		x			x	1	
MW-118	x		x			x	1	
MW-119	x		x			x	2	
MW-120	x		x			x	2	

TABLE 2
Groundwater Sampling Locations

[a]Ryznar parameters include calcium, total alkalinity, and total dissolved solids.
[b]Field Measurements include oxidation-reduction potential, pH, dissolved oxygen, temperature, and conductivity.
[c]Duplicate was collected for calcium, total alkalinity, and total dissolved solids. MS was collected for calcium only.
Notes:
DUP - field duplicate
MS/MSD - matrix spike/matrix spike duplicate
MW - monitoring well
PDSB - passive diffusion sampling bag
PZ - piezometer
VOC - volatile organic compound

TABLE 3
IDW Analytical Data for Volatile Organic Compounds

	Tank P4208	**Tank P4388**	**Bin R2121RT**	**Bin R2164ML**
	EPA ID 02414278	EPA ID 02414279	EPA ID 02414276	EPA ID 02414277
Compound	ug/l		ug/kg	
Dichlorodifluoromethane	0.5U	0.5U	2.5U	2.7U
Chloromethane	1.0U	1.0U	2.5U	2.7U
Vinyl Chloride	**0.25**	0.5U	2.5U	2.7U
Bromomethane	2.0U	2.0U	2.5U	2.7U
Chloroethane	0.5U	0.5U	2.5U	2.7U
Trichlorofluoromethane	0.5U	0.5U	2.5U	2.7U
1,1-Dichloroethene	0.5U	0.5U	2.5U	2.7UJ
Freon 113	1.0U	1.0U	2.5U	2.7U
Acetone	**1.9**	4.0U	**8.6J**	**10.6J**
Carbon Disulfide	1.0U	1.0U	**2.4J**	13.4UJ
Methyl acetate	2.0U	2.0U	2.5U	2.7U
Methylene Chloride	1.0U	1.0U	2.5U	2.7U
trans-1,2-Dichloroethene	0.5U	0.5U	2.5U	2.7UJ
Methyl-t-butyl ether	0.5U	0.5U	2.5U	2.7U
1,1-Dichloroethane	0.5U	0.5U	2.5U	2.7U
cis-1,2-Dichloroethene	**9.4**	**0.49**	2.5U	2.7U
2-Butanone	4.0U	4.0U	24.8U	**2.7J**
Bromochloromethane	0.5U	0.5U	2.5U	2.7U
Chloroform	0.5U	0.5U	2.5U	2.7U
1,1,1-Trichloroethane	0.5U	0.5U	2.5U	2.7U
Cyclohexane	0.5U	0.5U	2.5U	2.7U
Carbon Tetrachloride	1.0U	1.0U	2.5U	2.7U
Benzene	0.5U	0.5U	2.5U	2.7UJ
1,2-Dichloroethane	0.5U	0.5U	2.5U	2.7U
Trichloroethene	**3.1**	**0.63**	2.5U	2.7U
Methyl cyclohexane	0.5U	0.5U	2.5U	2.7U
1,2-Dichloropropane	0.5U	0.5U	2.5U	2.7U
Bromodichloromethane	0.5U	0.5U	2.5U	2.7U
cis-1,3-Dichloropropene	0.53U	0.53U	2.6U	2.8U
4-Methyl-2-pentanone	1.0U	1.0U	12.4U	13.4U
Toluene	0.5U	0.5U	2.5U	2.7U
trans-1,3-Dichloropropene	0.47U	0.47U	2.3U	2.5U
1,1,2-Trichloroethane	0.5U	0.5U	2.5U	2.7U
Tetrachloroethene	**3.1**	**1.9**	2.5U	**0.32J**
2-Hexanone	1.0U	1.0U	5.0U	5.4U
Dibromochloromethane	0.5U	0.5U	2.5U	2.7U
1,2-Dibromoethane	0.5U	0.5U	2.5U	2.7U
Chlorobenzene	0.5U	0.5U	2.5U	2.7U
Ethylbenzene	2.0U	**0.95**	**0.44J**	**0.58J**
m- + p-Xylene	1.0U	**2.2**	**1.4J**	**1.6J**
o-Xylene	0.5U	**2.5**	**0.39J**	**0.47J**
Styrene	0.5U	0.5U	2.5U	2.7U
Bromoform	0.5U	0.5U	2.5U	2.7U
Isopropylbenzene	5.0U	5.0U	2.5U	2.7U
1,1,2,2-Tetrachloroethane	0.5U	0.5U	2.5U	2.7U
1,3-Dichlorobenzene	0.5U	0.5U	2.5U	2.7U
1,4-Dichlorobenzene	0.5U	0.5U	2.5U	2.7U
1,2-Dichlorobenzene	0.5U	0.5U	2.5U	2.7U
1,2-Dibromo-3-chloropropane	1.0U	1.0U	12.4U	13.4U
1,2,4-Trichlorobenzene	2.0U	2.0U	2.5U	2.7U
1,2,3-Trichlorobenzene	0.5U	0.5U	2.5U	2.7U

Samples analyzed by Method OLC03.2 and OLM04.2.
Bold font indicates a detection.
U-The analyte was not detected at or above the reported value.
J-The identification of the analyte is acceptable; the reported value is an estimate.

TABLE 4
IDW Analytical Data for Polynuclear Aromatic Hydrocarbons

	Tank P4208 EPA ID 02414278	**Tank P4388** EPA ID 02414279	**Bin R2121RT** EPA ID 02414276	**Bin R2164ML** EPA ID 02414277
Compound	ug/l		ug/kg	
Naphthalene	0.37U	0.39U	161U	145U
Naphthalene, 2-methyl-	0.37U	0.39U	**51.9J**	145U
Napththalene, 1-methyl-	0.37U	**9.8**	**45J**	145U
2-Chloronaphthalene	0.37U	0.39U	161U	145U
Acenaphthylene	0.37U	**19.6**	161U	145U
Acenaphthene	0.37U	**593**	**868**	**368**
Dibenzofuran	0.37U	**57.6**	**523**	**74.6J**
9H-Fluorene	0.37U	**132**	**528**	**192**
Phenanthrene	0.37U	**0.31J**	**1740**	**504**
Anthracene	0.37U	14.4U	**140J**	**89.4J**
Fluoranthene	0.37U	**24.2**	**1020**	**1490**
Pyrene	0.37U	**11.8**	**737**	**987**
Retene	0.37U	0.39U	161U	145U
Benzo(a)anthracene	0.37U	0.46U	161U	152U
Chrysene	0.37U	**0.31J**	**79.9J**	**135J**
Benzo[b]fluoranthene	0.37U	0.39U	161U	145U
Benzl[k]fluoranthene	0.37U	0.39U	161U	145U
Benzo(a)pyrene	0.37U	0.39U	161U	145U
Indeno(1,2,3-cd)pyrene	0.37U	0.39U	161U	145U
Dibenzo[a,h]anthracene	0.37U	0.39U	161U	145U
Benzo(g,h,i)perylene	0.37U	0.39U	161U	145U

Samples analyzed by SW-846 8270C.
Bold font indicates a detection.
U-The analyte was not detected at or above the reported value.
J-The identification of the analyte is acceptable; the reported value is an estimate.

TABLE 5
IDW Analytical Data for Polyclorinated Biphenyls

	Tank P4208	Tank P4388	Bin R2121RT	Bin R2164ML
	EPA ID 02414278	EPA ID 02414279	EPA ID 02414276	EPA ID 02414277
Compound	ug/l		ug/kg	
PCB-1221	0.98 U	1 U	41 U	37 U
PCB-1232	0.49 U	0.5 U	20 U	18 U
PCB-1016	0.49 U	0.5 U	20 U	18 U
PCB-1242	0.49 U	0.5 U	20 U	18 U
PCB-1248	0.49 U	0.5 U	20 U	18 U
PCB-1254	0.49 U	0.5 U	20 U	**14 J**
PCB-1260	0.49 U	0.5 U	20 U	18 U
PCB-1262	0.49 U	0.5 U	20 U	18 U
PCB-1268	0.49 U	0.5 U	20 U	18 U

Samples analyzed by SW-846 8082.
Bold font indicates a detection.
U-The analyte was not detected at or above the reported value.
J-The identification of the analyte is acceptable; the reported value is an estimate.

TABLE 6
2002 Groundwater Analytical Data
Chemicals of Concern and Associated Breakdown Products (μg/l)

Station ID[1]	Sample Number	Sample Date	PCE	TCE	cis-1,2-DCE	Vinyl Chloride	1,1-DCE	trans-1,2-DCE	1,1-DCA	1,1,1-TCA
PZ-05 P	02414256	10/9/2002	145 J	21.3	16.3	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
PZ-06 P	02414257	10/9/2002	2.5	2.6	5	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
PZ-06 P D	02414258	10/9/2002	2.3	2.7	5	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
PZ-13 P	02414259	10/9/2002	0.28 J	1.1	9	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
MW-01	02414200	10/8/2002	77	13.5	7	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
MW-02	02414201	10/8/2002	0.5 U	2.9	41.5	105 JK	0.72	0.58	0.5 U	0.5 U
MW-03	02414203	10/8/2002	0.5 U	2.6	3.3	0.84 JK	0.5 U	0.5 U	0.5 U	0.5 U
MW-04	02414204	10/10/2002	0.5 U	59.9	1490	47.1	1.9	18.3	0.5 U	0.5 U
MW-04 P	02414205	10/11/2002	32.2	163	979	33.4	1.1	4	0.5 U	0.5 U
MW-05	02414206	10/8/2002	0.5 U	0.5 U	2	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
MW-06	02414207	10/9/2002	0.5 U	0.93	53.8	12.1 JK	0.5 U	0.26 J	0.5 U	0.5 U
MW-07	02414208	10/8/2002	0.81	4.2	35.9	4.3 JK	0.5 U	0.5 U	0.5 U	0.5 U
MW-08	02414209	10/10/2002	0.5 U	0.5 U	1 U	1 U	0.5 U	1 U	0.5 U	0.5 U
MW-09	02414210	10/10/2002	0.5 U	0.5 U	1 U	1 U	0.5 U	1 U	0.5 U	0.5 U
MW-10	02414211	10/10/2002	0.5 U	0.5 U	1 U	1 U	0.5 U	1 U	0.5 U	0.5 U
MW-11	02414224	10/11/2002	0.5 U	0.5 U	1 U	1 U	0.5 U	1 U	0.5 U	0.5 U
MW-12	02414233	10/11/2002	0.5 U	1.5	1 U	1 U	0.5 U	1 U	0.5 U	0.5 U
MW-13	02414234	10/10/2002	0.5 U	0.5 U	1 U	1 U	0.5 U	1 U	0.5 U	0.5 U
MW-14	02414235	10/9/2002	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
MW-14 D	02414236	10/9/2002	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
MW-15	02414237	10/9/2002	51.3	3.8	2.4	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
MW-15 P	02414238	10/11/2002	16.4	3.3	1.9	1 U	0.5 U	1 U	0.5 U	0.5 U
MW-16	02414239	10/10/2002	30.9	31.8	63	1 U	1.4	1.7	1.7	0.5 U
MW-17	02414240	10/11/2002	0.79	0.5 U	1 U	1 U	0.5 U	1 U	0.5 U	0.5 U
MW-18	02414241	10/8/2002	0.5 U	84.4 J	1550 J	201 JK	11.6	16	0.5 U	0.5 U
MW-19 U	02414242	10/10/2002	32.5	37.4	65.4	1 U	1.5	1.5	1.9	0.5 U
MW-19 L	02414243	10/10/2002	32.4	38	77	1 U	1.6	1.4	2	0.5 U
MW-20 U	02414244	10/10/2002	33.6	41.7	98.2	3	0.5 U	1 U	0.5 U	0.5 U
MW-20 L	02414245	10/10/2002	35.2	43.8	103	3.3	0.5 U	1 U	0.5 U	0.5 U
MW-20 P	02414260	10/11/2002	31.2	42.7	99.6	3.7	0.5 U	1 U	0.5 U	0.5 U
MW-21 U	02414246	10/8/2002	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
MW-21 L	02414247	10/8/2002	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
MW-22	02424248	10/14/2002	0.5 U	0.5 U	1 U	1 U	0.5 U	1 U	0.5 U	0.5 U
MW-23 U	02424249	10/14/2002	0.5 U	0.5 U	0.37 J	1 U	0.5 U	1 U	0.5 U	0.5 U
MW-23 L	02424250	10/14/2002	0.5 U	0.5 U	0.42 J	1 U	0.5 U	1 U	0.5 U	0.5 U
MW-24	02414251	10/8/2002	2.4	0.96	0.34 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
MW-25	02414252	10/8/2002	9.8	2.6	1.5	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
MW-DOT5	02414253	10/10/2002	0.5 U	0.5 U	1 U	1 U	0.5 U	1 U	0.5 U	0.5 U
MW-DOT6	02414254	10/10/2002	0.5 U	3.1	2.4	1 U	0.5 U	1 U	0.5 U	0.5 U
MW-DOT6 D	02414255	10/10/2002	0.5 U	4.1	2.3	1 U	0.5 U	1 U	0.5 U	0.5 U
MW-101	02424212	10/8/2002	17.2	7.3	7.3	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
MW-102	02424213	10/8/2002	5.5	17.3	21.4	2.9 JK	0.51	0.5 U	0.5 U	0.5 U
MW-103	02414214	10/14/2002	237	53.1	44.5	2.2	0.51	0.5 U	0.5 U	0.5 U
MW-103 P	02414215	10/11/2002	239	56.6	46.9	2.5	0.51	0.5 U	0.5 U	0.5 U
MW-104	02414216	10/9/2002	99.6	20.7	23.5	6.5 JK	0.75	2.5 U	0.5 U	0.5 U
MW-105	02414217	10/9/2002	9.9	2.8	2.6	1.3 JK	0.5 U	0.5 U	0.5 U	0.5 U
MW-105 D	02414218	10/9/2002	9.5	2.6	2.6	1.3 JK	0.5 U	0.5 U	0.5 U	0.5 U
MW-106	02414219	10/8/2002	1.8	1.6	2.4	0.93 JK	0.5 U	0.5 U	0.5 U	0.5 U
MW-107	02414220	10/10/2002	0.5 U	0.5 U	1 U	1 U	0.5 U	1 U	0.5 U	0.5 U
MW-107 D	02414221	10/10/2002	0.5 U	0.5 U	1 U	1 U	0.5 U	1 U	0.5 U	0.5 U

TABLE 6
2002 Groundwater Analytical Data
Chemicals of Concern and Associated Breakdown Products (μg/l)

Station ID[1]	Sample Number	Sample Date	PCE	TCE	cis-1,2-DCE	Vinyl Chloride	1,1-DCE	trans-1,2-DCE	1,1-DCA	1,1,1-TCA
MW-108	02424222	10/14/2002	0.26 J	0.62	1 U	1 U	0.5 U	1 U	0.5 U	0.5 U
MW-109	02424223	10/14/2002	0.2 J	0.73	1 U	1 U	0.5 U	1 U	0.5 U	0.5 U
MW-110	02424225	10/14/2002	0.39 J	0.41 J	0.56	1 U	0.5 U	1 U	0.5 U	0.5 U
MW-111	02424226	10/14/2002	1	1	1	1 U	0.5 U	1 U	0.5 U	0.5 U
MW-113	02414227	10/9/2002	19	34.5	201 J	0.28	0.5 U	0.5 U	0.5 U	0.5 U
MW-114	02414228	10/9/2002	15.8	18.5	10.6	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
MW-115	02414229	10/9/2002	2	3.4	110 J	23.9 JK	0.31 J	0.66	0.5 U	0.5 U
MW-116	02414230	10/9/2002	2.1	8.8	32.8	6.2 JK	0.34 J	0.24 J	0.5 U	0.5 U
MW-117	02414231	10/9/2002	1.1	1.8	97.3 J	30.3 JK	0.37 J	0.48 J	0.5 U	0.5 U
MW-118	02414232	10/9/2002	16.5	129 J	149 J	11.3 JK	1.5	1.2	0.5 U	0.5 U
MW-119 U	02444003	10/31/2002	0.5 U	0.5 U	0.5 U	1 U	1 U	0.5 U	0.5 U	0.5 U
MW-119 L	02444004	10/31/2002	0.5 U	0.5 U	0.5 U	1 U	1 U	0.5 U	0.5 U	0.5 U
MW-120 U	02444005	10/31/2002	0.5 U	0.5 U	0.5 U	1 U	1 U	0.5 U	0.5 U	0.5 U
MW-120 L	02444006	10/31/2002	0.5 U	0.5 U	0.5 U	1 U	1 U	0.5 U	0.5 U	0.5 U

Note:

(1) Letters after Station ID indicate the following: D = duplicate sample; P = sample collected via low-flow sampling method; U = PDSB placed at the upper part of the well screen; L = PDSB placed at the lower part of the well screen; sample collection at all other Station IDs without letter modifiers collected using a single PDSB at the midpoint of the well screen.

U-The analyte was not detected at or above the reported value.

J-The reported value is an estimate.

JK-The reported value is an estimate an may be biased high.

Shaded rows are locations where both PDSB and low-flow sampling methods were used.

TABLE 7
1997 to 2002 Groundwater COC Analytical Data

Sample Location	Total Depth	Aquifer Level	Screen Interval	PCE[1], µg/L (Remediation Goal: 1.0 µg/L)							TCE[2] µg/L (Remediation Goal: 1.6 µg/L)							Vinyl Chloride, µg/L (Remediation Goal: 1.0 µg/L)						
				Mar-97	Feb-98	Apr-99	Aug-00	Jul-01[4]	Oct-02	PCE Trend	Mar-97	Feb-98	Apr-99	Aug-00	Jul-01	Oct-02	TCE Trend	Mar-97	Feb-98	Apr-99	Aug-00	Jul-01	Oct-02	VC[3] Trend
Plume 1																								
DOT-05	101	Deep	95 - 100	1 U	--	1 U	1 U	0.5 U	0.5 U	ND	1 U	--	1 U	1 U	0.71	0.5 U	ND/NE	1 U	--	1 U	1 U	0.5 U	1 U	ND
DOT-06	20	Shallow	14 - 19	1 U	--	1 U	0.08 J	0.5 U	0.5 U	ND/NE	8	--	6.7	4.6	0.5 U	4.1	Decreasing to ND	0.7 J	--	1 U	1 U	0.5 U	1 U	ND
MW-04	13.1	Shallow	8 - 12	11,000	--	5,510	1890 J	2,500	32.2	Decreasing	320	--	226	833 J	1,100	163	Decreasing	100 J	--	121	291 J	300	47.1	Variable
MW-05	13.2	Shallow	8 - 13	1 U	--	1 U	1 U	0.5 U	0.5 U	ND[5]	1 U	--	1 U	1 U	0.5 U	0.5 U	ND	1	--	1 U	1 U	0.5 U	0.5 U	ND
MW-06	13	Shallow	8 - 12	13	--	1 U	0.81 J	0.5 U	0.5 U	Decreasing to ND	28	--	13.1	0.28 J	0.62	0.93	Decreasing to NE[6]	35	--	65.1	41.4	3.2	12.1	Variable
MW-07	13.6	Shallow	8.5 - 12.5	21	--	41.4	38.2	10U	0.81	Decreasing to NE	48	--	54.9	47.6	2J	4.2	Decreasing	28	--	18.3	11.1	4J	2.4	Decreasing
MW-09	86	Deep	80 - 85	1 U	--	1 U	1 U	0.5 U	0.5 U	ND	1 U	--	0.32 J	0.31 J	0.5 U	0.5 U	ND/NE	1 U	--	1 U	1 U	0.5 U	1 U	ND
MW-10	35	Intermediate	29 - 34	1 U	--	1 U	0.15 J	0.5 U	0.5 U	ND/NE	10	--	7.2	0.19 J	0.5 U	0.5 U	Decreasing to ND	1 U	--	1 U	1 U	0.5 U	1 U	ND
MW-11	66.5	Deep	60.5 - 65.5	1 U	--	1 U	1 U	0.5 U	0.5 U	ND	1 U	--	0.56 J	0.95 J	1.5	0.5 U	ND/NE	1 U	--	1 U	1 U	0.5 U	1 U	ND
MW-12	39	Intermediate	33 - 38	1 U	--	0.13 J	1 U	0.5 U	0.5 U	ND/NE	1 U	--	0.48 J	0.44 J	1.1	1.5	ND/NE	1 U	--	1 U	1 U	0.5 U	1 U	ND
MW-13	88	Deep	83 - 87	1 U	--	1 U	1 U	0.5 U	0.5 U	ND	1 U	--	1 U	1 U	0.5 U	0.5 U	ND	1 U	--	1 U	1 U	0.5 U	1 U	ND
MW-14	89.7	Deep	85 - 90	0.66 J	--	1 U	1 U	0.5 U	0.5 U	ND	1 U	--	1 U	1 U	0.5 U	0.5 U	ND	1 U	--	1 U	1 U	0.5 U	0.5 U	ND
MW-16	50	Intermediate	44 - 48	9.1	5.4	3	1 U	44	30.9	Increasing	4.9	3.7	2.2	1	32	31.8	Increasing	0.88 J	1 U	1 U	1 U	0.5 U	1 U	ND
MW-18	51.5	Intermediate	45 - 50	38.5	54.5	49.6	14.4	0.5 U	0.5 U	ND	132	38.4	216	12.7	34 E	84.4	Increasing	5.8	715	122	22.9	200 D	201	Steady
MW-19	15	Shallow	5 - 15	12.4	6.3	4	35.6	51	32.5	Decreasing?	7.4	3.8	3	32.7	43	38	Steady	0.73 J	1 U	1 U	1.5	0.5 U	1 U	ND
MW-22	33.5	Intermediate	28 - 33	2 U	--	1 U	0.17 J	0.5 U	0.5 U	NE/ND	2 U	--	1 U	0.20 J	0.5 U	0.5 U	NE/ND	2 U	--	1 U	1 U	0.5 U	1 U	ND
MW-23	14	Shallow	4 - 14	2 U	--	1 U	1 U	0.5 U	0.5 U	ND	2 U	--	1 U	0.41 J	0.5 U	0.5 U	NE/ND	2 U	--	1 U	1 U	0.5 U	1 U	ND
MW-107	20	Shallow	14 - 19	--	--	--	1 U	0.5 U	0.5 U	ND	--	--	--	1 U	0.5 U	0.5 U	ND	--	--	--	1 U	0.5 U	1 U	ND
MW-108	20	Shallow	15 - 20	--	--	--	1 U	0.5 U	0.26	NE/ND	--	--	--	1 U	0.56	0.62	NE/ND	--	--	--	1 U	0.5 U	1 U	ND
MW-109	40	Intermediate	35 - 40	--	--	--	1 U	0.5 U	0.2	NE/ND	--	--	--	1 U	0.82	0.73	NE/ND	--	--	--	1 U	0.5 U	1 U	ND
MW-110	40	Intermediate	35 - 10	--	--	--	1 U	0.5 U	0.39	NE/ND	--	--	--	1 U	0.5 U	0.41	NE/ND	--	--	--	1 U	0.5 U	1 U	ND
MW-111	20	Shallow	15 - 20	--	--	--	1 U	1.7	1	At RG	--	--	--	1 U	1.7	1	NE	--	--	--	1 U	0.5 UJ	1 U	ND
Plume 2																								
MW-02	15.8	Shallow	11 - 15	5	--	1.6	1	9	0.5 U	ND	13	--	3.1	5	18	2.9	Decreasing	19	--	20.6	53.9	30 D	105	Increasing
MW-03	16.2	Shallow	11.5 - 15.5	0.7 J	--	0.38 J	0.33 J	0.65	0.5 U	NE/ND	3	--	4.2	4.8	3	2.6	Steady	0.7 J	--	0.81 J	0.9 J	0.5 U	0.84	NE/ND
MW-101	20	Shallow	11.5 - 15.5	--	--	--	1.7	24 D	17.2	Decreasing?	--	--	--	1.3	10	7.3	Decreasing?	--	--	--	1 U	0.5 UJ	0.5 U	ND
MW-102	20	Shallow	15 - 20	--	--	--	7	8.9	5.5	Steady	--	--	--	55	18	17.3	Steady	--	--	--	14.3	2.5	1	At RG
MW-103	40	Intermediate	35 - 40	--	--	--	213	270 D	239	Steady	--	--	--	59.1	56 D	56.6	Steady	--	--	--	1.1	5 DJ	2.5	Variable
MW-104	20	Shallow	15 - 20	--	--	--	48.1	9	99.6	Increasing	--	--	--	14.8	6.9	20.7	Increasing	--	--	--	7.1	2.2	6.5	Variable
MW-105	40	Intermediate	35 - 40	--	--	--	2.3	9.2	9.9	Steady	--	--	--	1 U	2.3	2.8	Steady	--	--	--	1 U	1	1.3	At RG
MW-106	20	Shallow	15 - 20	--	--	--	1.1	0.73	1.8	At RG	--	--	--	1.3	1.9	1.6	At RG	--	--	--	1 U	1.1	0.92	At RG
MW-113	20	Shallow	15 - 20	--	--	--	--	--	19		--	--	--	--	--	34.5		--	--	--	--	--	0.28	
MW-114	40	Intermediate	35 - 40	--	--	--	--	--	15.8		--	--	--	--	--	18.5		--	--	--	--	--	0.5 U	
Plume 3																								
MW-01	18	Shallow	13 - 17	630 D	--	128	59	90 D	77	Variable	97 D	--	29.8	8.2	9.5	13.5	Variable	1	--	1 U	1 U	0.5 U	0.5 U	ND
MW-15	50	Intermediate	45 - 50	60.5	5680	899	48.8	2.8	51.3	Increasing	13.5	763	88.4	5.6	1.8	3.8	Increasing	1	1U	1 U	1 U	0.5 U	0.5 U	ND
MW-21	100.5	Deep	93 - 103	2 U	--	1 U	1 U	0.99	0.5 U	ND/NE	2 U	--	1 U	1 U	0.5 U	0.5 U	ND	2 U	--	1 U	1 U	0.5 U	0.5 U	ND
MW-24	50	Intermediate	45 - 50	--	1.3	2.3	0.58 J	1.4	2.4	Slight Increase	--	1 U	0.45 J	0.29 J	0.53	0.96	NE	--	1 U	1 U	1 U	0.5 U	0.5 U	ND
MW-25	50	Intermediate	45 - 50	--	0.55 J	1.9	0.82 J	5.4	9.8	Slight Increase	--	0.36	1.1	0.53 J	1.6	2.6	At RG	--	1 U	1 U	1 U	0.5 U	0.5 U	ND
PZ-05	40	Intermediate	35 - 40	--	--	191	81.4 J	68 D	145	Increasing	--	--	30.7 J	12.2	10	21.3	Increasing	--	--	1 U	1 U	0.5 U	0.5 U	ND
PZ-06	40	Intermediate	35 - 40	--	--	0.72 J	0.49 J	0.72	2.5	Slight Increase	--	--	0.3 J	0.29 J	0.97	2.7	Slight Increase	--	--	1 U	1 U	0.5 U	0.5 U	ND
PZ-13	12	Shallow	7 - 12	--	--	0.17 J	124 J	49 D	0.28	NE	--	--	0.16 J	61.1 J	35 D	1.1	NE	--	--	1 U	1 U	0.5 U	0.5 U	ND
Plume 4																								
MW-17	51.5	Intermediate	45 - 50	1 U	1 U	1 U	1 U	8.8	0.79	NE	1 U	1 U	1 U	1 U	9	0.5 U	ND	1 U	1 U	1 U	1 U	0.5 U	1 U	ND
MW-20	14.5	Shallow	4.5 - 14.5	0.5 J	1.2	8.5	42.2	61	35.2	Decreasing	2.2	4.6	18.3	105	100	43.8	Decreasing	3.2	2.8	1.9	7.8	4.8	3.7	Variable
ner Plant 2 Area																								
MW-115	20	Shallow	15 - 20	--	--	--	--	--	2		--	--	--	--	--	3.4		--	--	--	--	--	23.9	
MW-116	40	Intermediate	35 - 40	--	--	--	--	--	2.1		--	--	--	--	--	8.8		--	--	--	--	--	6.2	
MW-117	20	Shallow	15 - 20	--	--	--	--	--	1.1		--	--	--	--	--	1.8		--	--	--	--	--	30.3	
MW-118	40	Intermediate	35 - 40	--	--	--	--	--	16.5		--	--	--	--	--	129 J		--	--	--	--	--	11.3	
MW-119	112	Deep	102 - 112	--	--	--	--	--			--	--	--	--	--			--	--	--	--	--		
MW-120	105	Deep	95 - 105	--	--	--	--	--			--	--	--	--	--			--	--	--	--	--		

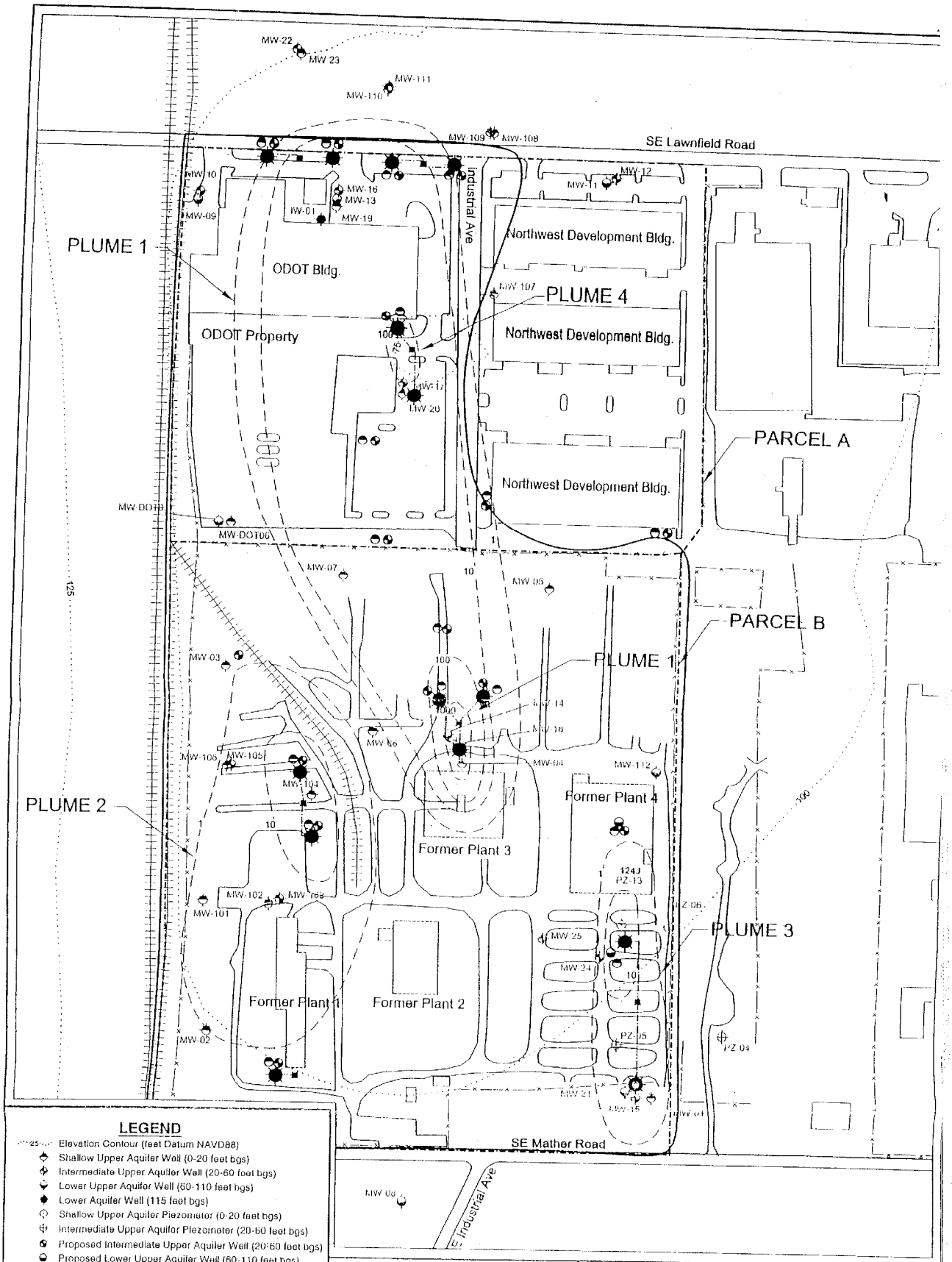
Note:
(1) PCE - Tetrachloroethene.
(2) TCE - Trichloroethene.
(3) VC - Vinyl Chloride.
(4) PDB - Passive Diffusion Bag. During 2001 groundwater sampling event, PDBs results were, on average 174% higher than low-flow sampling results.
(5) ND - Non-Detect.
(6) NE - Non Exceedance of Remediation Goal.
(7) RG - Remediation Goal.
Shaded values exceed the Remediation Goal.

TABLE 8
Ryznar Index Parameter Results

Station ID	Sample Number	Sample Date	Alkalinity as $CaCO_3$ (mg/L)	Total Dissolved Solids (mg/L)	Total Calcium (mg/L)	pH	S	C	Ryznar Value
MW-4	02414205	10/11/2002	99	173	30.9	6.4	23.04	7.2	9.48
MW-15	02414238	10/11/2002	104	170	23.8	6.4	23.05	7.1	9.51
MW-15 Dup	02414261	10/11/2002	104	172	24.3	6.4	23.04	6.9	9.70
MW-20	02414260	10/11/2002	150	247	43.6	6.4	23.08	7.7	9.94
MW-103	02414215	10/11/2002	122	186	25.2	7.6	23.05	7.0	8.49

TABLE 9
Fall 2002 Groundwater Elevation Data

Station ID	Total Depth (feet bgs)	Measure Point	Depth to Water (feet)	Top of Casing Elev. (feet)	Groundwater Elev. (feet)	Aquifer
PZ-05	40	TOC	8.85	115.76	106.91	Intermediate Upper
PZ-06	40	TOC	9.14	115.85	106.71	Intermediate Upper
PZ-13	12	TOC	8.47	115.39	106.92	Shallow Upper
MW-01	18.0	TOC	8.52	115.52	107.00	Shallow Upper
MW-02	15.8	TOC	8.69	114.51	105.82	Shallow Upper
MW-03	16.2	TOC	8.14	112.53	104.39	Shallow Upper
MW-04	13.1	TOC	8.44	114.64	106.20	Shallow Upper
MW-05	13.2	TOC	9.13	114.01	104.88	Shallow Upper
MW-06	13.0	TOC	7.74	113.49	105.75	Shallow Upper
MW-07	13.6	TOC	7.37	112.03	104.66	Shallow Upper
MW-08	72.0	TOC	9.24	115.75	106.51	Deep Upper
MW-09	86.0	TOC	3.58	106.04	102.46	Deep Upper
MW-10	35.0	TOC	2.95	106.02	103.07	Intermediate Upper
MW-11	66.5	TOC	4.76	107.40	102.64	Deep Upper
MW-12	39.0	TOC	4.89	107.67	102.78	Intermediate Upper
MW-13	88.0	TOC	2.94	105.71	102.77	Deep Upper
MW-14	89.7	TOC	9.63	115.35	105.72	Deep Upper
MW-15	50.0	TOC	9.60	116.59	106.99	Intermediate Upper
MW-16	50.0	TOC	2.69	105.60	102.91	Intermediate Upper
MW-17	51.5	TOC	4.02	107.50	103.48	Intermediate Upper
MW-18	51.5	TOC	9.40	115.34	105.94	Intermediate Upper
MW-19	15.0	TOC	2.79	105.77	102.98	Shallow Upper
MW-20	14.5	TOC	2.25	107.28	105.03	Shallow Upper
MW-21	100.5	TOC	9.16	116.03	106.87	Deep Upper
MW-22	33.5	TOC	6.82	108.56	101.74	Intermediate Upper
MW-23	14.0	TOC	6.44	108.28	101.84	Shallow Upper
MW-24	50.0	TOC	8.29	115.05	106.76	Intermediate Upper
MW-25	50.0	TOC	8.92	115.64	106.72	Intermediate Upper
MW-DOT5	101.0	TOC	7.08	111.10	104.02	Deep Upper
MW-DOT6	20.0	TOC	7.10	111.30	104.20	Shallow Upper
MW-101	15-20	TOC	8.59	114.14	105.55	Shallow Upper
MW-102	15-20	TOC	8.05	113.86	105.81	Shallow Upper
MW-103	40-50	TOC	7.99	113.95	105.96	Intermediate Upper
MW-104	15-20	TOC	8.56	113.93	105.37	Shallow Upper
MW-105	40-50	TOC	7.62	112.61	104.99	Intermediate Upper
MW-106	15-20	TOC	7.96	112.79	104.83	Shallow Upper
MW-107	15-20	TOC	5.49	108.27	102.78	Shallow Upper
MW-108	15-20	TOC	5.95	107.69	101.74	Shallow Upper
MW-109	40-50	TOC	5.98	108.02	102.04	Intermediate Upper
MW-110	40-50	TOC	5.84	107.31	101.47	Intermediate Upper
MW-111	15-20	TOC	6.54	107.20	100.66	Shallow Upper
MW-112	115-120	TOC	7.17	113.47	106.30	Lower Aquifer
MW-113	19	TOC	8.46	112.57	104.11	Shallow Upper
MW-114	40	TOC	8.74	112.78	104.04	Intermediate Upper
MW-115	20	TOC	8.78	113.74	104.96	Shallow Upper
MW-116	39	TOC	9.30	113.77	104.47	Intermediate Upper
MW-117	20	TOC	8.04	112.79	104.75	Shallow Upper
MW-118	40	TOC	8.62	112.76	104.14	Intermediate Upper
MW-119	112	TOC	8.72	113.88	105.16	Deep Upper
MW-120	105	TOC	9.05	113.30	104.25	Deep Upper



LEGEND

- 25 Elevation Contour (feet Datum NAVD88)
- Shallow Upper Aquifer Well (0-20 feet bgs)
- Intermediate Upper Aquifer Well (20-60 feet bgs)
- Lower Upper Aquifer Well (60-110 feet bgs)
- Lower Aquifer Well (115 feet bgs)
- Shallow Upper Aquifer Piezometer (0-20 feet bgs)
- Intermediate Upper Aquifer Piezometer (20-60 feet bgs)
- Proposed Intermediate Upper Aquifer Well (20-60 feet bgs)
- Proposed Lower Upper Aquifer Well (60-110 feet bgs)
- Proposed Shallow Upper Aquifer Well (0-20 feet bgs)
- In Situ Air Stripping Equipment Building
- Piping
- In Situ Air Stripping Well (bottom at 50 feet bgs.)
- In Situ Air Stripping Well (bottom at 70 feet bgs.)

0 50 100 200
SCALE IN FEET

NOTES

1) Contours based on interpretation of 2000 shallow upper aquifer PCE concentrations.

2) Bold contour represents total area of PCE, TCE and vinyl chloride exceedance as reported by Weston 1999.

3) Contour interval units in ug/L.

Figure 10-2
Northwest Pipe and Casing
Alternative G3b - In Situ Air Stripping Source Control and In Situ Air Stripping Plume Interception

EPA REGION 10

030-RI-CO-10GB
Northwest Pipe and Casing
GW MONITORING REPORT (JULY - AUG. 2000) & GW INVESTIGATION ADDENDUM

FILENAME: T:\RAC\NWP&C\Sub-Tasks\Annual GW 2000\Alt G-3b.dwg
EDIT DATE: 01/18/01 AT: 13:43

Project: NW Pipe & Casing OU 2 Remedial Design
Project Location: Clackamas, Oregon
Project Number: 33754161

Key to Log of Boring / Well

Elevation feet	Depth, feet	SAMPLES: Location	SAMPLES: Sample Label	Drill Progress, 24-hour clock	Graphic Log	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
1	2	3	4	5	6	7	8	9

COLUMN DESCRIPTIONS

1. **Elevation:** Elevation in feet referenced to mean sea level (MSL) or site datum.
2. **Depth:** Depth in feet below the ground surface.
3. **Sample Location:** Type of soil sample collected at approximate depth interval shown; sampler symbols are explained below.
4. **Sample Label:** Sample identification number.
5. **Drill Progress:** Time, in 24-hour clock, recorded at events during downhole advance such as sample collection, drill rod addition, down time, and daily start and finish.
6. **Graphic Log:** Graphic depiction of subsurface material encountered; typical symbols are explained below.
7. **Material Description:** Description of material encountered; may include color, moisture, grain size, and density/consistency.
8. **Well Schematic and Details:** Schematic of well installation; materials are described in the column to the right of the well schematic; graphic symbols are explained below.
9. **Field Notes:** Comments and observations regarding drilling, drill rig behavior, cuttings, sampling, or well construction and development made by driller or field personnel.

TYPICAL SOIL GRAPHIC SYMBOLS

- Poorly graded SAND (SP)
- Well-graded SAND (SW)
- SAND with silt (SP-SM)
- SILTY SAND (SM)
- CLAY (CL)
- SILT (ML)
- SANDY SILT (ML)
- CLAYEY SILT (ML)
- Poorly graded GRAVEL (GP)
- Well-graded GRAVEL (GW)
- GRAVEL with silt (GP-GM)
- SILTY GRAVEL (GM)

TYPICAL WELL GRAPHIC SYMBOLS

- Blank casing concrete
- Blank casing in filter sand
- Blank casing in cement-bentonite grout
- Slotted casing in filter sand
- Blank casing in bentonite chips
- Bentonite chip backfill

TYPICAL SAMPLER GRAPHIC SYMBOLS

- 2-inch-OD unlined split spoon (SPT)
- Shelby tube (thin-wall, fixed head)
- 2.5-inch-OD Modified California, four 4-inch brass liners
- Grab sample
- 2.5-inch-OD Lang split barrel, three 6-inch brass liners
- Bulk sample

OTHER GRAPHIC SYMBOLS

- First water encountered at time of drilling (ATD)
- Water level measured in well on specified date
- Change in material properties within a stratum
- – – – Inferred contact between strata or gradational change in lithology

GENERAL NOTES

1. Soil classifications are based on the Unified Soil Classification System. Descriptions and stratum lines are interpretive; actual lithologic changes may be gradual. Field descriptions may have been modified to reflect results of lab tests.
2. Descriptions on these logs apply only at the specific boring locations and at the time the borings were advanced. They are not warranted to be representative of subsurface conditions at other locations or times.

Project: NW Pipe & Casing OU 2 Remedial Design
Project Location: Clackamas, Oregon
Project Number: 33754161

Log of Boring / Well MW-113

Sheet 1 of 1

Date(s) Drilled	**9/4/02**	Logged By	**D. Weatherby**	Reviewer	**D. Weatherby**
Drilling Method	**Air Rotary**	Drilling Contractor	**R & R Drilling**	Total Depth of Borehole	**20.0 feet**
Drill Rig Type	**B-16 ODEX Rig**	Drill Bit Size/Type	**6-inch carbide underreemer**	Top of Casing Elevation	**112.57 feet MSL**
Sampling Method	**No sampling performed**	Hammer Data	**SD-5 air hammer**	Ground Surface Elevation	**110.05 feet MSL**
Water Level and Date Measured	**5.94 feet bgs on 9/24/02**	Borehole Completion	**Monitoring well installed (see schematic): 2-in.-OD PVC casing screened 15-20 ft**		

Elevation, feet	Depth, feet	SAMPLES: Location	SAMPLES: Sample Label	Drill Progress, 24-hour clock	Graphic Log	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
110	0			10:51		Slightly moist, brown, CLAYEY SILT (ML), trace gravel	Stick-up monument set in concrete; Concrete (0-1 ft); 6-inch-dia. borehole (0-20 ft)	No soil samples collected. Material descriptions based on drill cuttings and drilling observations.
105	5					Moist, brown, GRAVEL with silt and sand (GP-GM), ~80% gravel consisting mostly of rounded basalt	Bentonite chips (1-13 ft)	Driller's breathing zone (DBZ) PID reading = 0.6 ppm.
100	10					Becomes wet; decreasing silt content; slight hydrocarbon sheen on cuttings	Sch. 40 PVC blank casing, 2-inch OD (to 15 ft)	DBZ PID=0 ppm.
95	15						10-20 silica sand filter pack (13-20 ft)	
90	20			12:20		**Boring completed to depth of 20 feet on 9/4/02.**	Sch. 40 PVC screen, 2-inch OD, 20-slot (15-20 ft)	
85	25							
	30							

Report: GEO_12W_PORT_AR; File: OU2REMED.GPJ; 10/30/2002 MW-113

URS

Project: NW Pipe & Casing OU 2 Remedial Design
Project Location: Clackamas, Oregon
Project Number: 33754161

Log of Boring / Well MW-114

Date(s) Drilled	**9/4/02**	Logged By	**D. Weatherby**	Reviewer	**D. Weatherby**
Drilling Method	**Air Rotary**	Drilling Contractor	**R & R Drilling**	Total Depth of Borehole	**40.0 feet**
Drill Rig Type	**B-16 ODEX Rig**	Drill Bit Size/Type	**6-inch carbide underreemer**	Top of Casing Elevation	**112.78 feet MSL**
Sampling Method	**No sampling performed**	Hammer Data	**SD-5 air hammer**	Ground Surface Elevation	**110.11 feet MSL**
Water Level and Date Measured	**6.07 feet bgs on 9/24/02**	Borehole Completion	**Monitoring well installed (see schematic): 2-in.-OD PVC casing screened 35-40 ft**		

Elevation, feet	Depth, feet	SAMPLES: Location	SAMPLES: Sample Label	Drill Progress, 24-hour clock	Graphic Log	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
110	0			14:00		Slightly moist, brown, CLAYEY SILT (ML), trace gravel	Stick-up monument set in concrete; Concrete (0-1 ft)	No soil samples collected. Material descriptions based on drill cuttings and drilling observations.
							6-inch-dia. borehole (0-40 ft)	
105	5					Moist, brown, GRAVEL with silt and sand (GP-GM), ~80% gravel consisting mostly of rounded basalt	Bentonite chips (1-33 ft)	
100	10					Becomes wet; decreasing silt content	Sch. 40 PVC blank casing, 2-inch OD (to 35 ft)	
95	15			14:26				Driller's breathing zone (DBZ) PID reading = 0 ppm.
90	20							
85	25			15:14				DBZ PID=0 ppm.
						Drilling through large boulders (driller estimates 3 feet in diameter)		
	30			16:00				

Report: GEO_12W_PORT_AR; File: OU2REMED.GPJ; 10/30/2002 MW-114

URS

Project: NW Pipe & Casing OU 2 Remedial Design
Project Location: Clackamas, Oregon
Project Number: 33754161

Log of Boring / Well MW-114

Elevation, feet	Depth, feet	SAMPLES: Location	SAMPLES: Sample Label	Drill Progress, 24-hour clock	Graphic Log	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
80	30			16:00		Wet, brown, GRAVEL with silt and sand (GP-GM), ~80% gravel consisting mostly of rounded basalt (continued)	Bentonite chips (1-33 ft); Sch. 40 PVC blank casing, 2-inch OD (to 35 ft); 10-20 silica sand filter pack (33-40 ft); Sch. 40 PVC screen, 2-inch OD, 20-slot (35-40 ft)	
75	35							
70	40			17:30		**Boring completed to depth of 40 feet on 9/4/02.**		
65	45							
60	50							
55	55							
50	60							
	65							

Report: GEO_12W_PORT_AR; File: OU2REMED.GPJ; 10/30/2002 MW-114

URS

Project: NW Pipe & Casing OU 2 Remedial Design
Project Location: Clackamas, Oregon
Project Number: 33754161

Log of Boring / Well MW-115

Sheet 1 of 1

Date(s) Drilled	**9/5/02**	Logged By	**D. Weatherby**	Reviewer	**D. Weatherby**
Drilling Method	**Air Rotary**	Drilling Contractor	**R & R Drilling**	Total Depth of Borehole	**20.0 feet**
Drill Rig Type	**B-16 ODEX Rig**	Drill Bit Size/Type	**6-inch carbide underreemer**	Top of Casing Elevation	**113.74 feet MSL**
Sampling Method	**No sampling performed**	Hammer Data	**SD-5 air hammer**	Ground Surface Elevation	**110.97 feet MSL**
Water Level and Date Measured	**6.01 feet bgs on 9/25/02**	Borehole Completion	**Monitoring well installed (see schematic): 2-in.-OD PVC casing screened 15-20 ft**		

Elevation, feet	Depth, feet	SAMPLES: Location	SAMPLES: Sample Label	Drill Progress, 24-hour clock	Graphic Log	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
110	0			09:44		Dry, dark gray, CLAYEY SILT (ML), trace gravel	Stick-up monument set in concrete; Concrete (0-1 ft)	No soil samples collected. Material descriptions based on drill cuttings and drilling observations.
						Becomes moist, brown	6-inch-dia. borehole (0-20 ft)	
105	5					Moist, brown, GRAVEL with silt and sand (GP-GM), ~80% gravel consisting mostly of rounded basalt	Bentonite chips (1-13 ft)	
100	10					Wet, brown, GRAVEL with sand (GP), ~80% gravel consisting mostly of rounded basalt, trace silt	Sch. 40 PVC blank casing, 2-inch OD (to 15 ft)	
						Hydrocarbon sheen on cuttings; intermittent creosote-like odor	10-20 silica sand filter pack (13-20 ft)	
95	15			10:25		Becomes slightly moist		Driller reports very hard drilling.
				10:47			Sch. 40 PVC screen, 2-inch OD, 20-slot (15-20 ft)	
90	20					**Boring completed to depth of 20 feet on 9/5/02.**		
85	25							
	30							

Report: GEO_12W_PORT_AR; File: OU2REMED.GPJ; 10/30/2002 MW-115

URS

Project: NW Pipe & Casing OU 2 Remedial Design
Project Location: Clackamas, Oregon
Project Number: 33754161

Log of Boring / Well MW-116

Date(s) Drilled	**9/5/02**	Logged By	**D. Weatherby**	Reviewer	**D. Weatherby**
Drilling Method	**Air Rotary**	Drilling Contractor	**R & R Drilling**	Total Depth of Borehole	**40.0 feet**
Drill Rig Type	**B-16 ODEX Rig**	Drill Bit Size/Type	**6-inch carbide underreemer**	Top of Casing Elevation	**113.77 feet MSL**
Sampling Method	**No sampling performed**	Hammer Data	**SD-5 air hammer**	Ground Surface Elevation	**111.03 feet MSL**
Water Level and Date Measured	**6.56 feet bgs on 9/25/02**	Borehole Completion	**Monitoring well installed (see schematic): 2-in.-OD PVC casing screened 35-40 ft**		

Elevation, feet	Depth, feet	SAMPLES: Location	SAMPLES: Sample Label	Drill Progress, 24-hour clock	Graphic Log	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
110	0			13:14		Dry, dark gray, CLAYEY SILT (ML), trace gravel	Stick-up monument set in concrete; Concrete (0-1 ft)	No soil samples collected. Material descriptions based on drill cuttings and drilling observations.
						Becomes moist, brown	6-inch-dia. borehole (0-40 ft)	
105	5					Moist, brown, GRAVEL with silt and sand (GP-GM), ~80% gravel consisting mostly of rounded basalt	Bentonite chips (1-33 ft)	
100	10					Becomes wet; decreasing silt content	Sch. 40 PVC blank casing, 2-inch OD (to 35 ft)	
95	15			14:23		Becomes very dense, slightly moist		Very hard and slow drilling. Boring is not producing water.
90	20			14:58		Becomes wet; hydrocarbon sheen on cuttings and formation water, creosote-like odor		Easier drilling from 20 to 30 ft. Boring producing a lot of water.
85	25							
	30			15:32				

Report: GEO_12W_PORT_AR; File: OU2REMED.GPJ; 10/30/2002 MW-116

URS

Project: NW Pipe & Casing OU 2 Remedial Design
Project Location: Clackamas, Oregon
Project Number: 33754161

Log of Boring / Well MW-116

Elevation, feet	Depth, feet	SAMPLES: Location	SAMPLES: Sample Label	Drill Progress, 24-hour clock	Graphic Log	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
80	30			15:32		Wet, brown, GRAVEL with silt and sand (GP-GM), ~80% gravel consisting mostly of rounded basalt; hydrocarbon sheen on cuttings and formation water, creosote-like odor (continued)	Bentonite chips (1-33 ft)	
							Sch. 40 PVC blank casing, 2-inch OD (to 35 ft)	
75	35			16:48		Very heavy sheen on cuttings and formation water, strong creosote-like odor	10-20 silica sand filter pack (33-40 ft)	
							Sch. 40 PVC screen, 2-inch OD, 20-slot (35-40 ft)	
70	40			17:30		**Boring completed to depth of 40 feet on 9/5/02.**		
65	45							
	50							
60								
	55							
55								
	60							
50								
	65							

Report: GEO_12W_PORT_AR; File: OU2REMED.GPJ; 10/30/2002 MW-116

URS

Project: NW Pipe & Casing OU 2 Remedial Design
Project Location: Clackamas, Oregon
Project Number: 33754161

Log of Boring / Well MW-117

Sheet 1 of 1

Date(s) Drilled	**9/6/02**	Logged By	**D. Weatherby**	Reviewer	**D. Weatherby**
Drilling Method	**Air Rotary**	Drilling Contractor	**R & R Drilling**	Total Depth of Borehole	**20.0 feet**
Drill Rig Type	**B-16 ODEX Rig**	Drill Bit Size/Type	**6-inch carbide underreemer**	Top of Casing Elevation	**112.79 feet MSL**
Sampling Method	**No sampling performed**	Hammer Data	**SD-5 air hammer**	Ground Surface Elevation	**109.80 feet MSL**
Water Level and Date Measured	**5.05 feet bgs on 9/24/02**	Borehole Completion	**Monitoring well installed (see schematic): 2-in.-OD PVC casing screened 15-20 ft**		

Elevation, feet	Depth, feet	SAMPLES: Location	SAMPLES: Sample Label	Drill Progress, 24-hour clock	Graphic Log	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
	0			07:30		Slightly moist, dark gray, CLAYEY SILT (ML), trace gravel	Stick-up monument set in concrete; Concrete (0-1 ft)	No soil samples collected. Material descriptions based on drill cuttings and drilling observations.
105	5					Moist, brown, GRAVEL with silt and sand (GP-GM), ~80% gravel consisting mostly of rounded basalt	6-inch-dia. borehole (0-20 ft); Bentonite chips (1-13 ft)	
100	10					Becomes wet; decreasing silt content	Sch. 40 PVC blank casing, 2-inch OD (to 15 ft)	
						Slight creosote-like odor from cuttings		
95	15						10-20 silica sand filter pack (13-20 ft); Sch. 40 PVC screen, 2-inch OD, 20-slot (15-20 ft)	
90	20			08:15		**Boring completed to depth of 20 feet on 9/6/02.**		
85	25							
80	30							

Report: GEO_12W_PORT_AR; File: OU2REMED.GPJ; 10/30/2002 MW-117

URS

Project: NW Pipe & Casing OU 2 Remedial Design
Project Location: Clackamas, Oregon
Project Number: 33754161

Log of Boring / Well MW-118

Date(s) Drilled	**9/6/02**	Logged By	**D. Weatherby**	Reviewer	**D. Weatherby**
Drilling Method	**Air Rotary**	Drilling Contractor	**R & R Drilling**	Total Depth of Borehole	**40.0 feet**
Drill Rig Type	**B-16 ODEX Rig**	Drill Bit Size/Type	**6-inch carbide underreemer**	Top of Casing Elevation	**112.76 feet MSL**
Sampling Method	**No sampling performed**	Hammer Data	**SD-5 air hammer**	Ground Surface Elevation	**110.07 feet MSL**
Water Level and Date Measured	**5.93 feet bgs on 9/24/02**	Borehole Completion	**Monitoring well installed (see schematic): 2-in.-OD PVC casing screened 35-40 ft**		

Elevation, feet	Depth, feet	SAMPLES: Location	SAMPLES: Sample Label	Drill Progress, 24-hour clock	Graphic Log	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
110	0			09:40		Slightly moist, dark gray, CLAYEY SILT (ML), trace gravel	Stick-up monument set in concrete; Concrete (0-1 ft)	No soil samples collected. Material descriptions based on drill cuttings and drilling observations.
105	5					Moist, brown, GRAVEL with silt and sand (GP-GM), ~80% gravel consisting mostly of rounded basalt	6-inch-dia. borehole (0-40 ft); Bentonite chips (1-33 ft)	
100	10					Becomes wet; decreasing silt content	Sch. 40 PVC blank casing, 2-inch OD (to 35 ft)	
						Creosote-like odor from cuttings		
95	15							
90	20			10:53		No noticeable creosote-like odor		
85	25							
	30			11:36				

URS

Project: NW Pipe & Casing OU 2 Remedial Design
Project Location: Clackamas, Oregon
Project Number: 33754161

Log of Boring / Well MW-118

Elevation, feet	Depth, feet	SAMPLES: Location	SAMPLES: Sample Label	Drill Progress, 24-hour clock	Graphic Log	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
80	30			11:36		Wet, brown, GRAVEL with silt and sand (GP-GM), ~80% gravel consisting mostly of rounded basalt (continued)	Bentonite chips (1-33 ft); Sch. 40 PVC blank casing, 2-inch OD (to 35 ft); 10-20 silica sand filter pack (33-40 ft); Sch. 40 PVC screen, 2-inch OD, 20-slot (35-40 ft)	
75	35							
70	40			12:43		**Boring completed to depth of 40 feet on 9/6/02.**		
65	45							
60	50							
55	55							
50	60							
	65							

Report: GEO_12W_PORT_AR; File: OU2REMED.GPJ; 10/30/2002 MW-118

URS

Project: NW Pipe & Casing OU 2 Remedial Design
Project Location: Clackamas, Oregon
Project Number: 33754161

Log of Boring / Well MW-119

Date(s) Drilled	**9/25/02 and 9/26/02**	Logged By	**D. Weatherby**	Reviewer	**D. Weatherby**
Drilling Method	**Air Rotary (dual-wall rotary)**	Drilling Contractor	**Tacoma Pump & Drilling**	Total Depth of Borehole	**140.0 feet**
Drill Rig Type	**Foremost DR-24**	Drill Bit Size/Type	**5-inch tricone bit (inner); 6-inch casing (outer)**	Top of Casing Elevation	**113.88 feet MSL**
Sampling Method	**No sampling performed**	Hammer Data	**Not applicable**	Ground Surface Elevation	**111.02 feet MSL**
Water Level and Date Measured	**5.86 feet bgs on 10/17/02**	Borehole Completion	**Monitoring well installed (see schematic): 2-in.-OD PVC casing screened 102-112 ft**		

Elevation, feet	Depth, feet	SAMPLES: Location	SAMPLES: Sample Label	Drill Progress, 24-hour clock	Graphic Log	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
	0			13:50 [9/25]		Dry, dark gray, CLAYEY SILT (ML), trace gravel	Stick-up monument set in concrete; Concrete (0-1 ft)	No soil samples collected. Material descriptions based on drill cuttings and drilling observations.
110						Becomes slightly moist, brown		
	5						6-inch-dia. borehole (0-140 ft)	
105						Moist, dark brown, GRAVEL with silt and sand (GP-GM), ~75% gravel consisting mostly of rounded basalt	Bentonite chips (1-99 ft)	
	10							
100						Becomes wet	Sch. 40 PVC blank casing, 2-inch OD (to 102 ft)	
	15							
95						Hydrocarbon sheen on cuttings, creosote-like odor		
				14:25 [9/25]				Shut down for day due to broken hydraulic line.
	20			07:30 [9/26]				
90								
	25							
85								
	30							

Report: GEO_12W_PORT_AR; File: OU2REMED.GPJ; 10/30/2002 MW-119

URS

Project: NW Pipe & Casing OU 2 Remedial Design
Project Location: Clackamas, Oregon
Project Number: 33754161

Log of Boring / Well MW-119

Elevation, feet	Depth, feet	SAMPLES: Location	SAMPLES: Sample Label	Drill Progress, 24-hour clock	Graphic Log	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
80	30					Wet, dark brown, GRAVEL with silt and sand (GP-GM), ~75% gravel consisting mostly of rounded basalt; hydrocarbon sheen on cuttings, creosote-like odor (continued)	6-inch-dia. borehole (0-140 ft)	
							Bentonite chips (1-99 ft)	
75	35						Sch. 40 PVC blank casing, 2-inch OD (to 102 ft)	
70	40					Heavy sheen, strong creosote-like odor		
65	45							
60	50					Increasing silt content		Boring producing less water.
55	55					Decreasing silt content		Boring producing more water.
50	60					Becomes dark gray; increasing silt content; discontinuous sheen, weak creosote-like odor		
	65							

Report: GEO_12W_PORT_AR; File: OU2REMED.GPJ; 10/30/2002 MW-119

Project: NW Pipe & Casing OU 2 Remedial Design
Project Location: Clackamas, Oregon
Project Number: 33754161

Log of Boring / Well MW-119

Elevation, feet	Depth, feet	SAMPLES: Location	SAMPLES: Sample Label	Drill Progress, 24-hour clock	Graphic Log	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
45	65					Wet, dark gray, GRAVEL with silt and sand (GP-GM), ~75% gravel consisting mostly of rounded basalt; discontinuous hydrocarbon sheen on cuttings, weak creosote-like odor (continued)	6-inch-dia. borehole (0-140 ft)	
40	70					Spotty sheen on cuttings, moderate creosote-like odor	Bentonite chips (1-99 ft)	
35	75			10:00		Wet, dark gray, GRAVEL with sand (GP), ~80% gravel consisting mostly of rounded basalt, trace fines; no sheen on cuttings, moderate creosote-like odor	Sch. 40 PVC blank casing, 2-inch OD (to 102 ft)	
30	80							
25	85							
20	90							
15	95			10:52		Weak to moderate creosote-like odor, no sheen		
	100						10-20 silica sand filter pack (99-112 ft)	

Report: GEO_12W_PORT_AR; File: OU2REMED.GPJ; 10/30/2002 MW-119

URS

Project: NW Pipe & Casing OU 2 Remedial Design
Project Location: Clackamas, Oregon
Project Number: 33754161

Log of Boring / Well MW-119

Elevation, feet	Depth, feet	SAMPLES: Location	SAMPLES: Sample Label	Drill Progress, 24-hour clock	Graphic Log	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
10						Wet, dark gray, GRAVEL with sand (GP), ~80% gravel consisting mostly of rounded basalt, trace fines; no sheen on cuttings, weak creosote-like odor (continued)	Sch. 40 PVC blank casing, 2-inch OD (to 102 ft)	
	105						10-20 silica sand filter pack (99-112 ft)	
5							Sch. 40 PVC screen, 2-inch OD, 20-slot (102-112 ft)	
	110							
0							Bentonite chips (112-140 ft)	
						Wet, dark gray, SANDY SILT to SILTY SAND (ML/SM); no sheen on cuttings, weak creosote-like odor		
	115			11:48				
-5						Wet, dark gray, GRAVEL with sand (GP), ~80% gravel consisting mostly of rounded basalt, trace fines; no sheen or odor		
	120							
-10								
	125							
-15								
	130							
-20								
	135							

URS

Project: NW Pipe & Casing OU 2 Remedial Design
Project Location: Clackamas, Oregon
Project Number: 33754161

Log of Boring / Well MW-119

Elevation, feet	Depth, feet	SAMPLES: Location	SAMPLES: Sample Label	Drill Progress, 24-hour clock	Graphic Log	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
-25						Wet, dark gray, GRAVEL with sand (GP), trace fines; no sheen or odor (continued)	6-inch-dia. borehole (0-140 ft)	
						Wet, dark gray, SANDY SILT (ML); no sheen or odor	Bentonite chips (112-140 ft)	
	140			13:30		**Boring completed to depth of 140 feet on 9/26/02.**		
-30								
	145							
-35								
	150							
-40								
	155							
-45								
	160							
-50								
	165							
-55								
	170							

Report: GEO_12W_PORT_AR; File: OU2REMED.GPJ; 10/30/2002 MW-119

URS

Project: NW Pipe & Casing OU 2 Remedial Design
Project Location: Clackamas, Oregon
Project Number: 33754161

Log of Boring / Well MW-120

Date(s) Drilled	**10/1/02**	Logged By	**D. Weatherby**	Reviewer	**D. Weatherby**
Drilling Method	**Air Rotary (dual-wall rotary)**	Drilling Contractor	**Tacoma Pump & Drilling**	Total Depth of Borehole	**125.0 feet**
Drill Rig Type	**Foremost DR-24**	Drill Bit Size/Type	**5-inch tricone bit (inner); 6-inch casing (outer)**	Top of Casing Elevation	**113.30 feet MSL**
Sampling Method	**No sampling performed**	Hammer Data	**Not applicable**	Ground Surface Elevation	**111.22 feet MSL**
Water Level and Date Measured	**6.97 feet bgs on 10/17/02**	Borehole Completion	**Monitoring well installed (see schematic): 2-in.-OD PVC casing screened 95-105 ft**		

Elevation, feet	Depth, feet	SAMPLES: Location	SAMPLES: Sample Label	Drill Progress, 24-hour clock	Graphic Log	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
110	0			08:55		Slightly moist, very dark brown, SILT with gravel (ML)	Stick-up monument set in concrete; Concrete (0-1 ft)	No soil samples collected. Material descriptions based on drill cuttings and drilling observations.
						Becomes grayish brown	6-inch-dia. borehole (0-125 ft)	
105	5							
						Wet, grayish brown, GRAVEL with silt and sand (GP-GM), ~80% gravel consisting mostly of rounded basalt; spotty, discontinuous hydrocarbon sheen on cuttings, weak creosote-like odor	Bentonite chips (1-92 ft)	
100	10						Sch. 40 PVC blank casing, 2-inch OD (to 95 ft)	
95	15							
90	20			09:08		Sheen becomes more prominent and continuous, moderate to strong creosote-like odor		
85	25							
	30							

Report: GEO_12W_PORT_AR; File: OU2REMED.GPJ; 10/30/2002 MW-120

URS

Project: NW Pipe & Casing OU 2 Remedial Design
Project Location: Clackamas, Oregon
Project Number: 33754161

Log of Boring / Well MW-120

Elevation, feet	Depth, feet	SAMPLES: Location	SAMPLES: Sample Label	Drill Progress, 24-hour clock	Graphic Log	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
80	30					Wet, grayish brown, GRAVEL with silt and sand (GP-GM), ~80% gravel consisting mostly of rounded basalt; continuous hydrocarbon sheen on cuttings, moderate to strong creosote-like odor (continued)	6-inch-dia. borehole (0-125 ft)	
75	35			09:34		Heavy hydrocarbon sheen on cuttings, strong creosote-like odor	Bentonite chips (1-92 ft)	
70	40						Sch. 40 PVC blank casing, 2-inch OD (to 95 ft)	
65	45							
60	50					Sheen becomes more spotty, less continuous, strong creosote-like odor		
55	55			10:04		Decreasing silt content; spotty hydrocarbon sheen on cuttings, strong creosote-like odor		Boring producing more water.
50	60					Becomes medium brown; increasing silt content		
	65							

Report: GEO_12W_PORT_AR; File: OU2REMED.GPJ; 10/30/2002 MW-120

URS

Project: NW Pipe & Casing OU 2 Remedial Design
Project Location: Clackamas, Oregon
Project Number: 33754161

Log of Boring / Well MW-120

Elevation, feet	Depth, feet	SAMPLES: Location	SAMPLES: Sample Label	Drill Progress, 24-hour clock	Graphic Log	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
45	65					Wet, medium brown, GRAVEL with silt and sand (GP-GM), ~80% gravel consisting mostly of rounded basalt; spotty hydrocarbon sheen on cuttings, strong creosote-like odor (continued)	6-inch-dia. borehole (0-125 ft)	
							Bentonite chips (1-92 ft)	
40	70					Wet, dark gray, GRAVEL with sand (GP), ~80% gravel consisting mostly of rounded basalt, trace fines; spotty hydrocarbon sheen on cuttings, strong creosote-like odor		Sandy gravel unit is quite water-bearing.
							Sch. 40 PVC blank casing, 2-inch OD (to 95 ft)	
35	75			11:07				
						Moderate to strong creosote-like odor		
30	80							
25	85							
20	90							
							10-20 silica sand filter pack (92-106 ft)	
15	95			12:12		Sheen becomes very spotty and discontinuous, moderate creosote-like odor		
							Sch. 40 PVC screen, 2-inch OD, 20-slot (95-105 ft)	
	100					No sheen, weak creosote-like odor		

Report: GEO_12W_PORT_AR; File: OU2REMED.GPJ; 10/30/2002 MW-120

URS

Project: NW Pipe & Casing OU 2 Remedial Design
Project Location: Clackamas, Oregon
Project Number: 33754161

Log of Boring / Well MW-120

Elevation, feet	Depth, feet	SAMPLES: Location	SAMPLES: Sample Label	Drill Progress, 24-hour clock	Graphic Log	MATERIAL DESCRIPTION	WELL SCHEMATIC AND CONSTRUCTION DETAILS	FIELD NOTES
10	100					Wet, dark gray, GRAVEL with sand (GP), ~80% gravel consisting mostly of rounded basalt, trace fines; no sheen on cuttings, weak creosote-like odor (continued)	10-20 silica sand filter pack (92-106 ft); Sch. 40 PVC screen, 2-inch OD, 20-slot (95-105 ft); Bentonite chips (106-125 ft)	Minimal water production in silty gravel unit.
5	105					Wet, grayish brown, GRAVEL with silt (GP-GM); no sheen on cuttings, weak creosote-like odor		
0	110					Wet, dark gray, GRAVEL with sand (GP), ~80% gravel consisting mostly of rounded basalt; no sheen or odor		
-5	115			12:49		Weak creosote-like odor, but no sheen		
-10	120							
	125			13:22		Wet, dark gray, SILT / SILTSTONE (ML), indurated, no gravel; no sheen or odor		
-15	125					**Boring completed to depth of 125 feet on 10/1/02.**		
-20	130							
	135							

Report: GEO_12W_PORT_AR; File: OU2REMED.GPJ; 10/30/2002 MW-120

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WELL DEVELOPMENT LOG FOR MW-113

Project Name: NW PIPE & CASING Project No: 33754161 Date: 9/17/02 Field Personnel: D. Weathersby	Well Depth: 20 ft. Well Diameter: 2 in. Volume of Water in Well: _____ gal.	Well Development Method: Submersible Pump Pump Discharge Rate: ~ 2 gpm Method of Disposal of Discharged Water: Bakker Tank

DEPTH TO WATER	TIME (24-hour)	PURGED (gallons)	pH (units)	Conductivity mS/cm (µS)	TEMP. (°C)	REMARKS
	1610	6	7.83	0.459	14.9	TURB = 999 DO = 1.62 mg/L
	1620	20	7.78	0.450	14.8	TURB = 999 DO = 1.38 mg/L
	1635	30	7.72	0.433	14.7	TURB = 999 DO = 1.66 mg/L
	1654	38	7.70	0.444	14.6	TURB = 936 DO = 1.98 mg/L
	1719	50	7.69	0.440	14.6	TURB = 999 DO = 2.19 mg/L
	1729	20	7.70	0.435	14.4	TURB = 472 DO = 1.95 mg/L
	1758	58	7.69	0.449	14.3	TURB = 249 DO = 2.21
	Development Complete.		pH, cond. & temp stable, but water continues to be turbid.			

Notes: No screen or hydrocarbon odor.

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WELL DEVELOPMENT LOG FOR MW-114

Project Name: NW PIPE & CASING	Well Depth: 40 ft.	Well Development Method: Submersible Pump
Project No: 33754161	Well Diameter: 2 in.	Pump Discharge Rate: ~ 2 gpm
Date: 9/17/02	Volume of Water In Well: ____ gal.	Method of Disposal of Discharged Water: Bakker Tank
Field Personnel: D. Weatherby		

DEPTH TO WATER	TIME (24-hour)	PURGED (gallons)	pH (units)	Conductivity ~~(µS)~~ mS/cm	TEMP. (°C)	REMARKS
	1606	4	7.89	0.322	14.0	TURB. = 999 DO = 0.35 mg/L
	1616	20	7.78	0.254	13.6	TURB = 999 DO = 1.02
	1626	20	7.76	0.268	13.5	TURB = 999 DO = 0.95
	1658	64	7.70	0.286	13.5	TURB = 999 DO = 2.31
	1722	48	7.69	0.288	13.3	TURB = 578 DO = 2.14
	1735	26	7.70	0.291	13.3	TURB = 104 DO = 2.22
	1754	38	7.66	0.286	13.2	TURB = 867 DO = 2.91
	Development Complete. pH, Cond. & temp stable, but water continuing to be turbid.					

Notes: No sheen or hydrocarbon odor.

URS

WELL DEVELOPMENT LOG FOR MW-115

Project Name: NW Pipe - Casing	Well Depth: 20 ft.	Well Development Method: Submersible Pump
Project No: 33754161	Well Diameter: 2 in.	Pump Discharge Rate: ~2 gpm
Date: 9/19/02	Volume of Water in Well: _____ gal.	Method of Disposal of Discharged Water: Bakker Tank
Field Personnel: D. Weatherby		

DEPTH TO WATER	TIME (24-hour)	PURGED (gallons)	pH (units)	Conductivity mS/cm (µS)	TEMP. (°C)	REMARKS
	0843	~86	8.05	0.322	16.4	TURB = 228 DO = 0.58 mg/L.
	0900	34	8.11	0.360	16.6	TURB = 10 DO = 0.89 mg/L.
	0914	28	8.10	0.358	16.7	TURB = 10 DO = 0.29 mg/L.
	Development	Complete.	Water clear & water quality parameters stable.			

Notes:

0800

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FORM 3

URS

WELL DEVELOPMENT LOG FOR MW-116

Project Name: NW Pipe + Casing Project No: 33754161 Date: 9/19/02 Field Personnel: D. Weatherby	Well Depth: 40 ft. Well Diameter: 2 in. Volume of Water In Well: _____ gal.	Well Development Method: Submersible Pump Pump Discharge Rate: ~2 gpm Method of Disposal of Discharged Water: Baker Tank

DEPTH TO WATER	TIME (24-hour)	PURGED (gallons)	pH (units)	Conductivity mS/cm (µS)	TEMP. (°C)	REMARKS
	0850	100	8.13	0.443	15.0	TURB = 575 DO = 2.58 mg/L
	0906	32	8.15	0.412	15.4	TURB = 474 DO = 0.32 mg/L
	0923	34	8.12	0.396	15.8	TURB = 189 DO = 0.52 mg/L
	0939	32	8.15	0.392	16.1	TURB = 121 DO = 0.28 mg/L
	1001	44	8.16	0.386	16.8	TURB = 38 DO = 0.37 mg/L
	1018	34	8.11	0.380	16.5	TURB = 95 DO = 0.24 mg/L
	1041	46	8.14	0.377	16.9	TURB = 10 DO = 0.23 mg/L
	Development Complete. Water clear, water quality parameters stable.					

Notes: Well initially produced a sheen + odor; as the water became clear, no odor/sheen was noted.

0800

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FORM 3

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WELL DEVELOPMENT LOG FOR MW-117

Project Name: NW Pipe + Casing
Project No: 33754161
Date: 9/18/02
Field Personnel: D. Weatherby

Well Depth: 20 ft.
Well Diameter: 2 in.
Volume of Water in Well: ____ gal.

Well Development Method: Submersible Pump
Pump Discharge Rate: ~2 gpm
Method of Disposal of Discharged Water: Baker Tank

DEPTH TO WATER	TIME (24-hour)	PURGED (gallons)	pH (units)	Conductivity mS/cm (µS)	TEMP. (°C)	REMARKS
	1138	~20	7.65	0.370	18.5	TURB = 999 DO = 0.30 mg/L
	1217	78	7.77	0.354	18.9	TURB = 999 DO = 0.30 mg/L
	1225	14	7.85	0.355	19.1	TURB = 60 DO = 0.37 mg/L
	1237	24	7.80	0.355	19.1	TURB = 84 DO = 0.31 mg/L
	Development Complete, Water running fairly clear. Water quality parameters stable.					

Notes: No screen or hydrocarbon odor.

URS

WELL DEVELOPMENT LOG FOR MW-118

Project Name: MW Pipe + Casing	Well Depth: 40 ft.	Well Development Method: Submersible Pump
Project No: 33754161	Well Diameter: 2 in.	Pump Discharge Rate: ~
Date: 9/18/02	Volume of Water in Well: _____ gal.	Method of Disposal of Discharged Water: Bakker Tank
Field Personnel: D. Weatherby		

DEPTH TO WATER	TIME (24-hour)	PURGED (gallons)	pH (units)	Conductivity ms/cm (~~µS~~)	TEMP. (°C)	REMARKS
	1141	~20	7.73	0.225	15.2	TURB = 999 DO = 0.80 mg/L
	1240	118	7.93	0.233	15.4	TURB = 401 DO = 1.08 mg/L.
	1250	20	7.90	0.225	15.1	TURB = 89 DO = 0.77 mg/L.
	1258	12	7.91	0.224	15.1	TURB = 24 DO = 0.87 mg/L.
	Development Complete.		Water very fairly clear.	Water quality parameters stable.		

Notes: No sheen or hydrocarbon odor.

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FORM 3

URS

WELL DEVELOPMENT LOG FOR MW-119

Project Name: NW Pipe + Casing
Project No: 33754161
Date: 10/2/02
Field Personnel: D. Weatherby

Well Depth: 112 ft.
Well Diameter: 2 in.
Volume of Water In Well: _____ gal.

Well Development Method: Submersible Pump
Pump Discharge Rate: ~1 gpm
Method of Disposal of Discharged Water: Bakker Tank

DEPTH TO WATER	TIME (24-hour)	PURGED (gallons)	pH (units)	Conductivity mS/cm (µS)	TEMP. (°C)	REMARKS
	1141	8l	6.1	0.287	14.0	TURB = 476 DO = 0.72 mg/L
	1204	23	6.87	0.212	14.0	TURB = 208 DO = 0.49 mg/L
	1234	30	7.04	0.207	14.0	TURB = 196 DO = 0.15 mg/L
	1249	15	7.12	0.205	13.8	TURB = 129 DO = 0.15 mg/L
	1305	16	7.10	0.204	13.9	TURB = 62 DO = 0.29 mg/L
	Development Complete					

Notes: No Sheen on water

FORM 3

URS

WELL DEVELOPMENT LOG FOR MW-120

Project Name: NW Pipe & Casing
Project No: 33754/61
Date: 10/2/02
Field Personnel: D. Weatherby

Well Depth: 105 ft.
Well Diameter: 2 in.
Volume of Water in Well: _____ gal.

Well Development Method: Submersible Pump
Pump Discharge Rate: ~ 1 gpm
Method of Disposal of Discharged Water: Rakker Tank

DEPTH TO WATER	TIME (24-hour)	PURGED (gallons)	pH (units)	Conductivity mS/cm (µS)	TEMP. (°C)	REMARKS
16.5 TOC	1411	48	7.53	0.232	14.7	TURB = 831 DO = 0.39 mg/L
16.2 TOC	1430	19	7.37	0.217	14.3	TURB = 273 DO = 0.29 mg/L
16.2 "	1450	20	7.28	0.208	13.9	TURB = 87 DO = 0.37 mg/L
16.2 "	1510	20	7.20	0.201	13.8	TURB = 29 DO = 0.58 mg/L
	Development Complete.					

Notes: No Sheen on Water.

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FORM 3

Sixty-three primary samples were collected by URS during the 2002 groundwater sampling at the NW Pipe & Casing/Hall Process Company (NWPC) site in Clackamas, Oregon. The analytical results were subject to a full data quality review by the EPA Region 10 Manchester Laboratory Supervisors and an EPA Region 10 Quality Assurance Chemist following the procedures specified in the *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review* (EPA, October 1999) and *Inorganic Data Review* (EPA, February 1994). In addition, URS conducted a review of field quality control samples. This report summarizes problems identified by the EPA and URS that resulted in qualification of data.

Samples were collected according to the Quality Assurance Project Plan (QAPP) prepared by URS. Samples were analyzed for the following:

- Polychlorinated biphenyl (PCB) Aroclors by EPA SW-846 Method 8082
- Polyaromatic hydrocarbons (PAHs) by EPA SW-846 Method 8270C
- Volatile Organic Compounds (VOCs) by EPA SW-846 Method 8260B[1]
- Alkalinity by Standard Method 2320B
- Total Dissolved Solids (TDS) by EPA Region 10 Manchester Environmental Laboratory Method I-1750
- Calcium by CLP SOW ILM04.1

All analyses were conducted by the EPA Region 10 Manchester Laboratory with the exception of the calcium analysis, which was conducted by American Analytical and Technical Services, Inc. of Broken Arrow, Oklahoma.

REPRESENTATIVENESS

Holding Times

All samples were properly preserved and analyzed within holding times.

ACCURACY

Instrument Calibration

Instrument tuning standards, initial calibrations and continuing calibrations were performed at the proper frequency and at the appropriate concentrations required by the methods. Calibrations were within criteria for the contaminants of concern.

Review of Blanks

Method blanks were used to check for laboratory contamination and instrument bias. The laboratory analyzed at least one blank for each analysis and for each batch per method requirements. Contaminants of concern were not detected in method blanks.

[1] This Data Quality Summary Report includes only those VOCs that are contaminants of concern or associated breakdown products: tetrachloroethene, trichloroethene, cis-1,2-dichloroethene, vinyl chloride, 1,1-dichloroethene, trans-1,2-dichloroethene, 1,1-dichloroethane, and 1,1,1-trichloroethane.

Six field blanks, seven equipment rinsate blanks, and six trip blanks were collected. One trip blank was not analyzed due to laboratory oversight. Data were not qualified as a result of this nonconformance. Contaminants of concern were not detected in the blanks.

Surrogate Recovery Review

Each sample was spiked with appropriate surrogates (system monitoring compounds). Surrogate recoveries were within method criteria with the exceptions listed below.

- The recoveries for the surrogate 1,2-dichloroethane-d4 in the VOC analysis were above the criterion for samples 0241265, 02414266, 02414274, 02414276, 02414277, and 02414280 through 02414282. The non-aromatic compounds were either non-detect in these samples or were detected at levels below the quantitation limits and already qualified as estimated ("J"); therefore, no additional qualifiers were applied.
- The recoveries for the surrogate p-bromofluorobenzene in the VOC analysis were below the criterion for samples 02414200, 02414201, 02414203, 02414208, 02414213, 02414219, 02414241, and 02414270. The aromatic target compound results for these samples were qualified as estimated ("J/UJ").
- The recoveries for the surrogate 1,2-dichloroethane-d4 were above the criterion for the diluted VOC reanalysis of samples 02414227, 02414229, 02414231, 02414232, 02414241, and 02414256. The detected results were qualified as estimated ("J").

Matrix Spike/Matrix Spike Duplicate Review

Matrix spike/matrix spike duplicate (MS/MSD) samples were analyzed to assess the ability of the laboratories to recover the target compounds from the sample matrix. One MS/MSD sample pair was analyzed for each sample batch as required.

Data were evaluated for percent recovery (% Rec) of target compounds and relative percent difference (RPD) between the compound recoveries in the MS and MSD.

Recoveries and RPDs that fell outside project criteria were attributed to the spike level being too low relative to the native concentrations and did not result in sample result qualification.

Compound Quantitation

Calculations were based on the initial calibration. Sample quantitation limits were adjusted according to sample amounts, calibration data and dilution factors. Some compounds were detected at levels below the lowest calibration concentration of the initial calibration curve. These values were qualified as estimated ("J").

The reported vinyl chloride result for sample 02424201 was above the calibration range and was qualified as estimated ("J").

PRECISION

Field Duplicate Review

Five field duplicates were collected for VOC analysis and one field duplicate was collected for alkalinity, TDS, and total calcium. Field duplicates were not collected for PAH and PCB analyses because these results were used only for investigation derived

waste characterization. Project-specific control limits for relative percent differences (RPDs) are 25% for VOCs and 20% for alkalinity, TDS and total calcium. Tables 1 (VOCs) and 2 (total alkalinity, TDS, and total calcium) present the field duplicate RPDs. The RPD is not calculated when sample results are less than five times the reporting limit. The field duplicate results show good agreement with the exception of the trichloroethene results for samples 02414235 and 02414236, which exceeded the VOC RPD criteria of 25% at 27.8%. The results were not qualified as a result of this minor exceedance.

COMPARABILITY

Reporting Limits

The requested reporting limits for analyses are listed below. The laboratory reporting limits are all at or below the requested reporting limits.

MATRIX	PARAMETER	REQUESTED REPORTING LIMIT
Water	VOCs	1 μg/L
Water	Calcium	50 μg/L
Water	Total Alkalinity	20 mg/L
Water	Total Dissolved Solids	20 mg/L
Water	PCBs	2 μg/L
Water	PAHs	25 μg/L
Soil	VOCs	10 ug/Kg
Soil	PCBs	0.1 mg/Kg
Soil	PAHs	2 mg/Kg

COMPLETENESS

The laboratory reported all requested analyses with one exception. Trip blank sample number 02414271 was not analyzed for VOCs due to laboratory oversight. The project completeness is 99.5%.

Based on the QA/QC review, the following qualifiers were applied to data:

- J – The identification of the analyte is acceptable; the reported value is an estimate.
- JK – The identification of the analyte is acceptable; the reported value is an estimate and may be biased high. The actual value is expected to be less than the reported value.
- UJ – The analyte was not detected at or above the reported value. The reported value is an estimate.

Tables 3, 4, 5, 6, and 8 in the main body of the report present the analytical data, including detected and undetected compounds and their associated data qualifiers.

TABLE 1
Field Duplicate
Relative Percent Difference
Chemicals of Concern and Associated Breakdown Products

Station ID	PZ-06 P		PZ-06 P D		RPD
Sample Number	02414257		02414258		
PCE	2.5		2.3		8.3
TCE	2.6		2.7		3.8
cis-1,2-DCE	5		5		0.0
Vinyl Chloride	0.5	U	0.5	U	0.0
1,1-DCE	0.5	U	0.5	U	0.0
trans-1,2-DCE	0.5	U	0.5	U	0.0
1,1-DCA	0.5	U	0.5	U	0.0
1,1,1-TCA	0.5	U	0.5	U	0.0

Station ID	MW-14		MW-14 D		RPD
Sample Number	02414235		02414236		
PCE	0.5	U	0.5	U	0.0
TCE	0.5	U	0.5	U	0.0
cis-1,2-DCE	0.5	U	0.5	U	0.0
Vinyl Chloride	0.5	U	0.5	U	0.0
1,1-DCE	0.5	U	0.5	U	0.0
trans-1,2-DCE	0.5	U	0.5	U	0.0
1,1-DCA	0.5	U	0.5	U	0.0
1,1,1-TCA	0.5	U	0.5	U	0.0

Station ID	MW-DOT6		MW-DOT6 D		RPD
Sample Number	02414254		02414255		
PCE	0.5	U	0.5	U	0.0
TCE	3.1		4.1		27.8
cis-1,2-DCE	2.4		2.3		4.3
Vinyl Chloride	1	U	1	U	0.0
1,1-DCE	0.5	U	0.5	U	0.0
trans-1,2-DCE	1	U	1	U	0.0
1,1-DCA	0.5	U	0.5	U	0.0
1,1,1-TCA	0.5	U	0.5	U	0.0

Station ID	MW-105		MW-105 D		RPD
Sample Number	02414217		02414218		
PCE	9.9		9.5		4.1
TCE	2.8		2.6		7.4
cis-1,2-DCE	2.6		2.6		0.0
Vinyl Chloride	1.3		1.3		0.0
1,1-DCE	0.5	U	0.5	U	0.0
trans-1,2-DCE	0.5	U	0.5	U	0.0
1,1-DCA	0.5	U	0.5	U	0.0
1,1,1-TCA	0.5	U	0.5	U	0.0

Station ID	MW-107		MW-107 D		RPD
Sample Number	02414220		02414221		
PCE	0.5	U	0.5	U	0.0
TCE	0.5	U	0.5	U	0.0
cis-1,2-DCE	1	U	1	U	0.0
Vinyl Chloride	1	U	1	U	0.0
1,1-DCE	0.5	U	0.5	U	0.0
trans-1,2-DCE	1	U	1	U	0.0
1,1-DCA	0.5	U	0.5	U	0.0
1,1,1-TCA	0.5	U	0.5	U	0.0

Note:
RPD - Relative Percent Difference
U -The analyte was not detected at or above the reported value.

TABLE 2
Field Duplicate
Relative Percent Difference
Ryznar Index Parameter Results

Station ID	MW-15	MW-15 Dup	RPD
Sample Number	02414238	02414261	
Alkalinity as $CaCO_3$ (mg/L)	104	104	0.0
Total Dissolved Solids (mg/L)	170	172	2.1
Total Calcium (mg/L)	23.8	24.3	2.1
pH	6.44	6.44	0.0

RPD - Relative Percent Difference